

Consulting Engineer

March 1960

WILBUR SMITH is one part Southerner, one part Connecticut Yankee, and to match that mixture his firm, Wilbur Smith and Associates, has two main offices, one in New Haven, Conn., the other in Columbia, S. C. And while Smith practices in the special field of traffic engineering, he is, according to his masters degree, an electrical engineer. The switch in fields can be explained by the timing of Smith's B.S. from the University of South Carolina. It was 1932, and there were not many jobs. The only work he could find

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Photo by Fabian Bachrach

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FABRICATIONS

This 240-ton tunnel shield, fabricated by ALCO, is being used by Perini Corp. to cut the second tube for Boston's Sumner Tunnel.

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March 1960 • VOLUME XIV • NUMBER III

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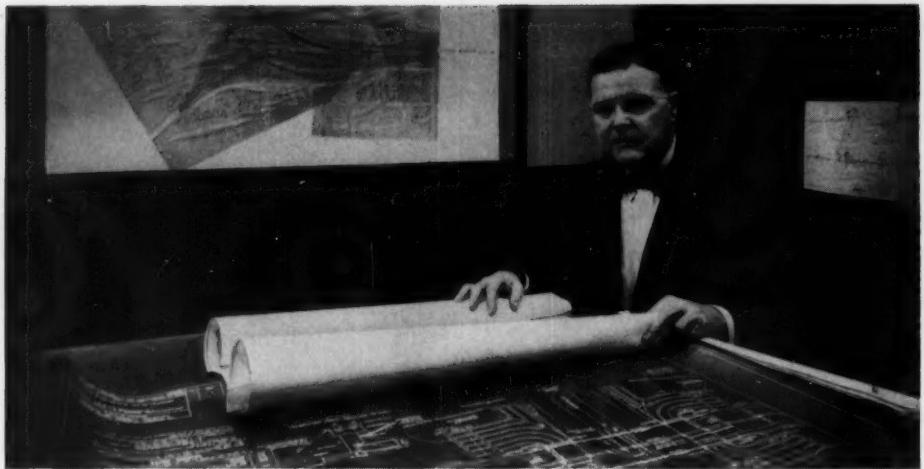
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Mr. Maurice N. Quade, Senior Partner of Parsons, Brinckerhoff, Hall & Macdonald,
designers of about 50 steel bridges a year.

One of the handsome steel bridges on the Prospect Avenue Expressway, Brooklyn, N.Y., designed by Parsons, Brinckerhoff, Hall & Macdonald.



Steel is a predominant structural material in short-span bridge work

at Parsons, Brinckerhoff, Hall and Macdonald, Consulting Engineers.

PARSONS, BRINCKERHOFF, HALL & MACDONALD will celebrate their 75th anniversary next year as consulting engineers in the civil engineering field. The scope of their work in the western hemisphere includes highways, bridges, tunnels, municipal and sanitary work, airports, river and harbor work, etc. In the highway field they designed between 50 and 60 short-span bridges in 1958, using rolled steel beams. Currently they have about 50 more on the boards.

Some of the projects include parts of the Bergen-Passaic Counties Interstate Expressway in New Jersey; the Prospect Avenue Expressway in Brooklyn, N.Y.; the Queen Elizabeth Way Connections in Hamilton, Ontario, Canada; the New York State Thruway; Northeast Expressway, Massachusetts.

Steel is an economical material

Mr. M. N. Quade, Senior Partner of the firm, says that the majority of short-span designs on their drawing boards are composite beam construction,

utilizing concrete decks. Combining steel beams with concrete makes it possible to save construction costs. Steel construction goes up fast and saves time and labor. The factors of economy, quick erection and availability all contribute to the fact that steel is a predominant material used in short-span bridge projects.

Increased facilities. There is an ever-expanding demand for steel because of its many advantages in the fast-growing market for bridge construction. The steel industry has had the foresight to grow with this vigorous market through greatly expanded facilities for manufacture of structural shapes and plates. You can confidently design in steel—the material you know best, the material that offers most—knowing it will be available.

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Quick erection, low cost, composite beam construction, reduction in traffic delays are a few reasons why structural steel is the predominant material for bridges.

Mr. Quade (left) shown with a new electronic computer system which his company uses to speed up engineering work in composite beam design and in figuring large projects.

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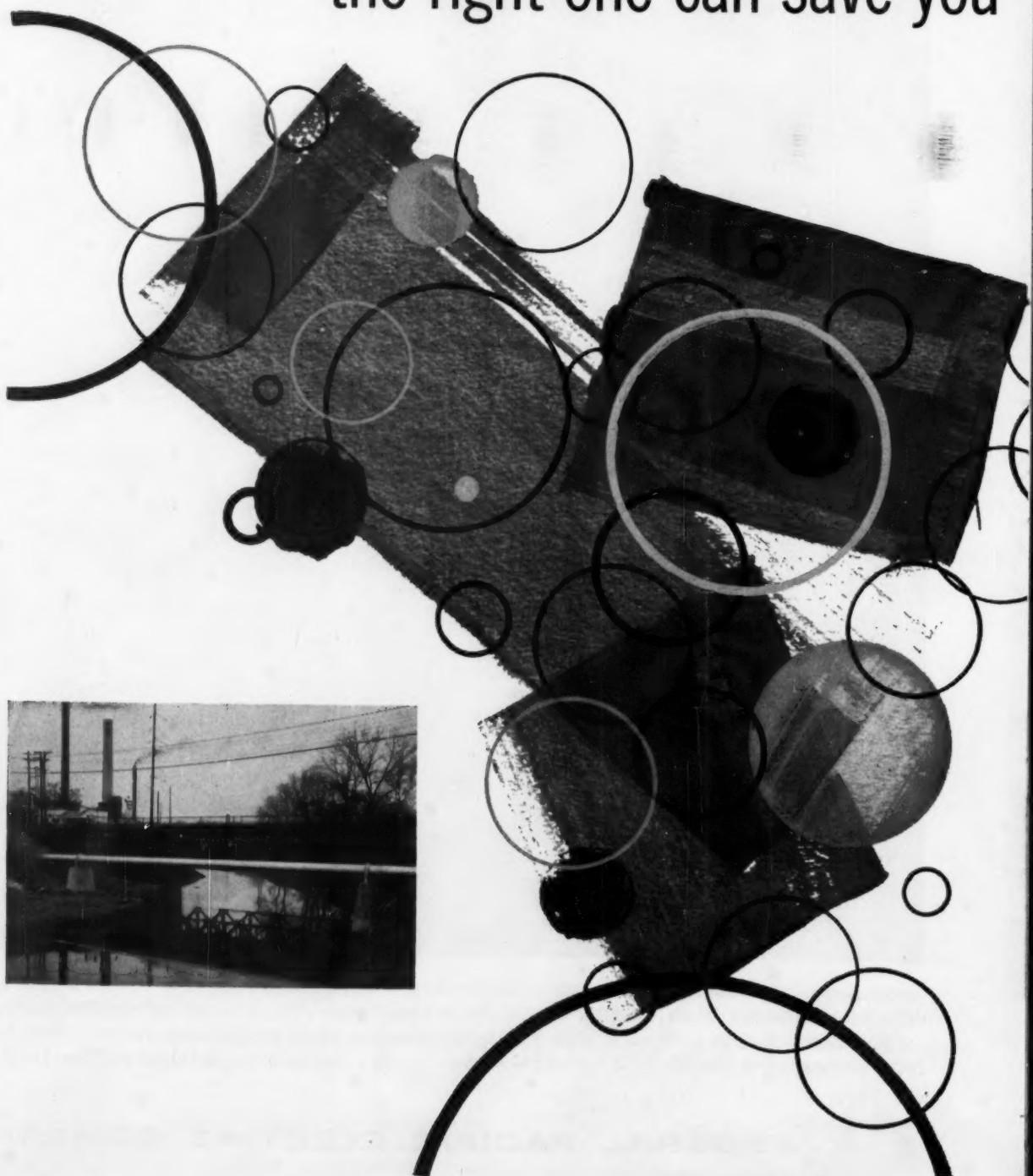


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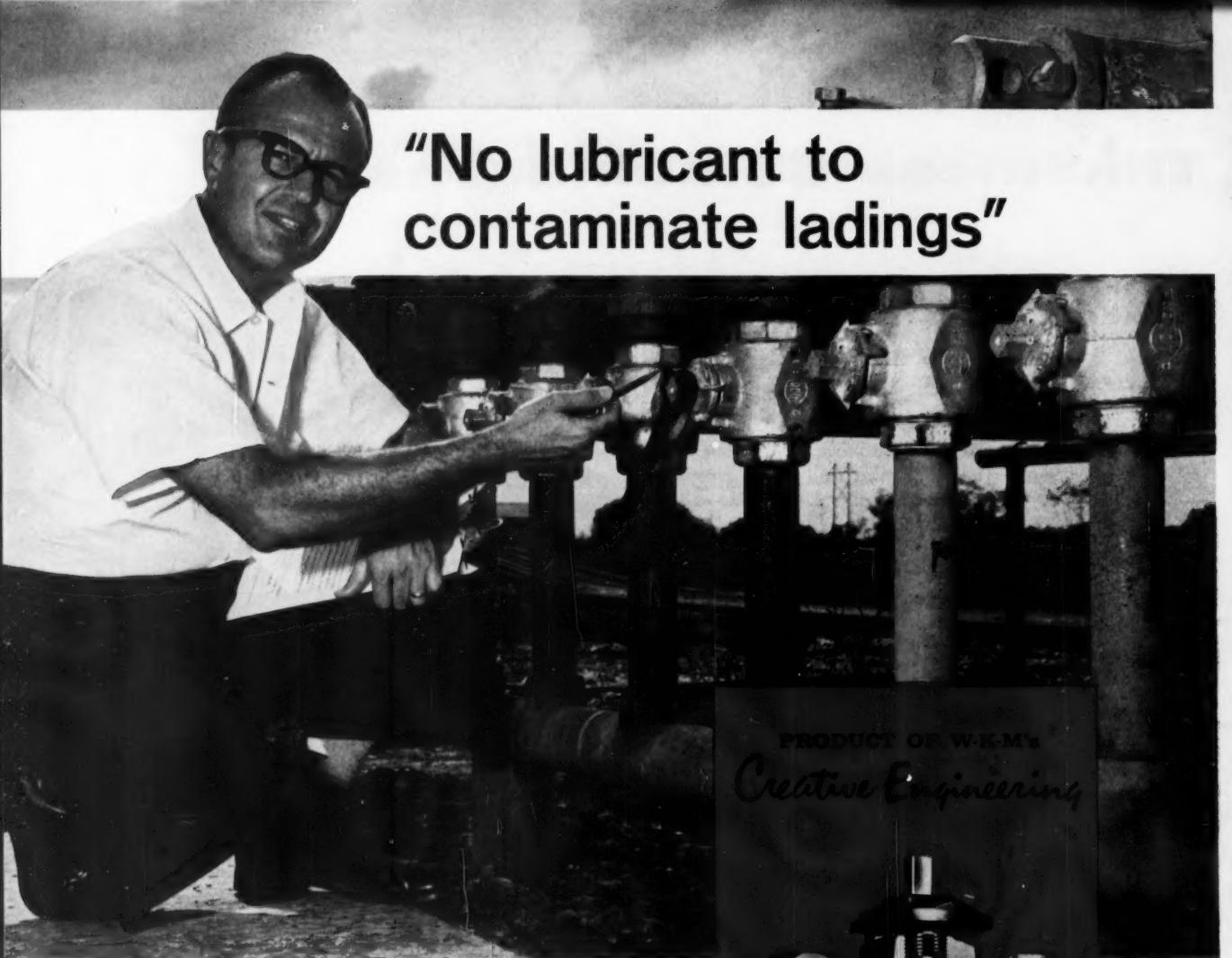
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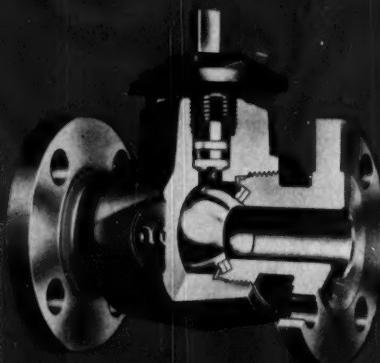
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SALES ENGINEERS IN PRINCIPAL CITIES

Wilbur Smith

- Starts on front cover

was as a laboratory instructor in the engineering department at \$22 a month, and to get it he had to continue in school as a graduate student. A year later he found himself with a master's degree in electrical engineering but still no job. The University offered no higher engineering degree at that time, so he had to find some sort of income-producing work.

The first job to show up was in the Motor Vehicle Division of the South Carolina Highway Department issuing driver's licenses and license plates. After a few months of this, the legislature authorized a survey of rural electrification potential in the state. This was about the beginning of REA, and the state was looking for some Federal funds to help electrify rural areas. But in the authorization of the survey, it was stipulated that no new state agency was to be set up, so the project was turned over to the highway department. As an electrical engineer, young Smith looked like the right man. With other highway engineers, he was taken off licenses and put on the electrical survey.

After this work was completed, he was moved to a survey party and then to the highway department laboratory in Columbia, and raised to about \$90 a month. Yet, it was the survey that might be thought of as one of the accidents that directed Smith's future. Just a year later, the opportunity to work on another survey arose, and Smith was an "experienced" survey man. This new survey was to deal with traffic, and it was to be conducted by FERA, one of the forerunners of PWA. Smith was appointed associate director. By pure chance Smith found himself, a young electrical engineer not long out of school, engaged in the new and scarcely defined field of traffic engineering — and he liked it.

As the FERA study was being completed, Charles Moorefield, then chief engineer of the S. C. State Highway Department, convinced the department that it needed a traffic engineering section, and Smith went to work there in 1935, as an assistant traffic engineer.

Up North to Harvard

Prior to this time Smith had been a Southerner, a Deep-Southerner, in every respect. Suddenly, that changed. He was offered a graduate fellowship to study at Harvard during the academic year 1936-37. The topic — traffic. Smith took a leave of absence from the highway department and moved north to Massachusetts.

In June 1937, he returned to the S. C. Highway Department as Traffic Engineer. He organized and directed the state's first traffic engineering depart-

ment. Three years later, however, he was confronted with another challenge. The Bureau of Highway Traffic, which had moved from Harvard to Yale, asked Smith to accept a one-year research project on "The Economics of Highway Transportation." And so, with the blessings of highway officials, he was off to the North again in 1940, switching from Harvard to Yale.

Completing the research assignment, he returned to Columbia and his job with the S. C. State Highway Department in June 1941.

Consulting on the Potomac

Then, in 1942, just after the beginning of World War II, Smith went to Washington to become a consultant on traffic and evacuation problems for the FBI. He also squeezed in some teaching at the University of South Carolina and Clemson — supervising special war courses having to do with safety engineering — and he managed to find additional time to act as Southeastern Regional Consultant for the Office of Civilian Defense. He went back to Yale in 1943 as Associate Director of the Bureau of Highway Traffic.

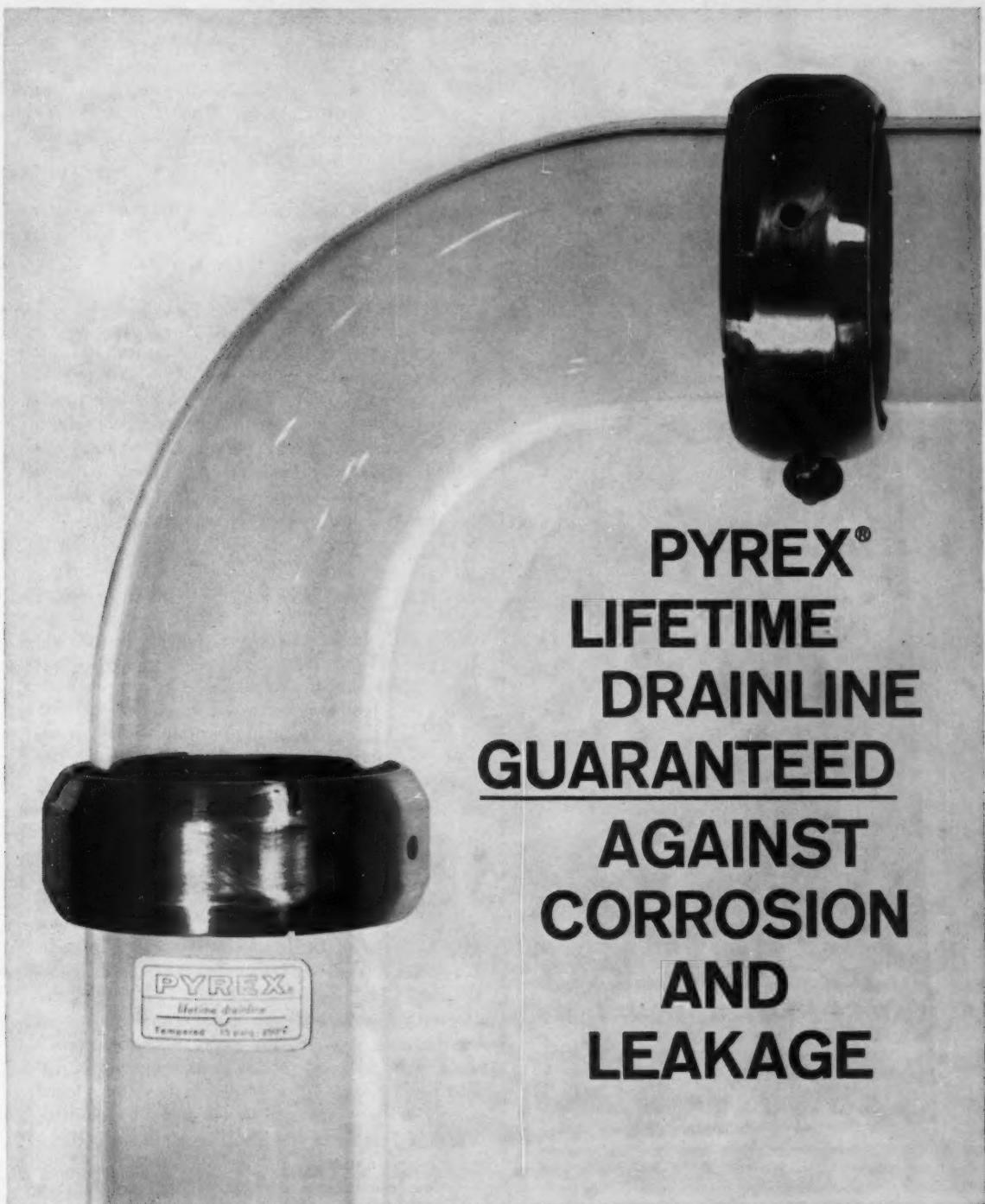
Two of those positions still take some of Smith's time. He lectures at Yale one day a week, one semester a year, and he still serves as a traffic consultant to the Federal Bureau of Investigation. His teaching does not interfere with his consulting work, however, since one of the firm's principal offices is located near the Yale campus. His course is for graduate engineers and is part of a curriculum in traffic engineering.

After the war, while engaged primarily in teaching, Wilbur Smith found himself more and more involved in consulting work. Gradually it became clear that he would have to decide on his true vocation. Would he be a teacher who did some consulting? Or would he be a consulting engineer who did a little teaching?

Consulting won, though the shift was gradual. In 1946, Smith joined with W. W. Dibble, a civil engineer, to form a partnership, Smith-Dibble and Company. This firm gradually built up its staff and its list of clients, practicing largely in the field of traffic and highway economic studies.

By 1952, Smith-Dibble was well on its way when Dibble retired from the partnership to open his own office. Smith continued on his own under the name of Wilbur Smith and Associates. The firm has grown so that it now has not only the Columbia and New Haven offices, but offices in Richmond, Va., Winston-Salem, N. C., Kansas City, Mo., and San Francisco, Calif. More than 100 persons work for the firm, about one third of them engineers.

While this firm has been growing, Smith also has associated himself with the engineer-architect



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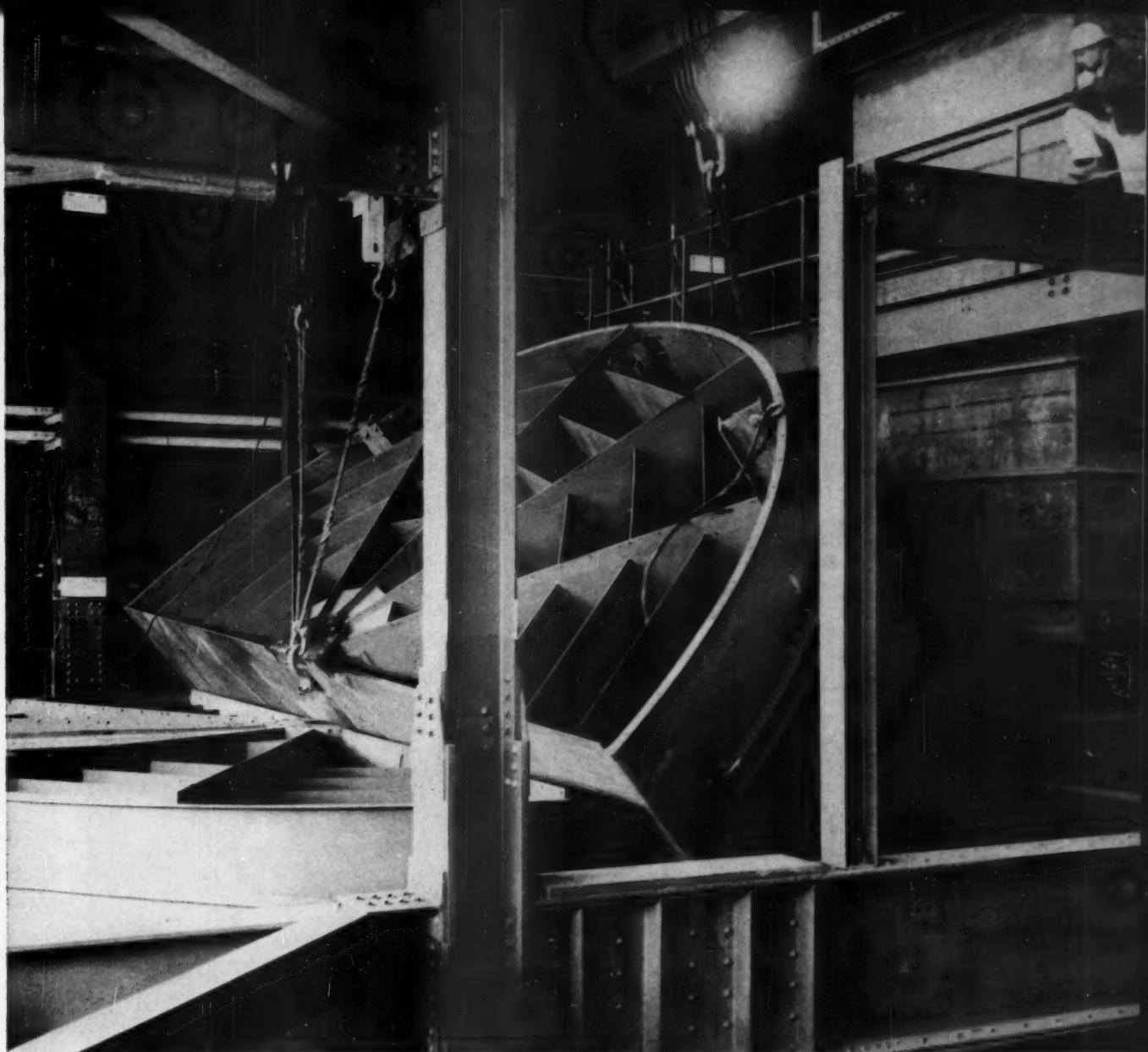
Every Man a Traffic Expert

Despite the fact that he had moved gradually into consulting work, it was not easy to find clients in the early days of practice. Smith's most difficult job throughout his whole consulting career has been to convince the client that he needed a traffic engineer—to make him see that scientific studies and engineering methods permit analysis and planning beyond that provided by the layman's native intuition. Most laymen will admit that they cannot design a bridge—but every man feels that he is a traffic expert.

"I suppose," Smith said, "every consulting engineer feels that he had a harder time getting started than any of his colleagues, and there is no doubt that design engineers have no easy task in finding first clients, but for traffic engineers it is even harder. Not only do you have to prove you have something they need, but you have the competition of self-styled 'experts' who are quite willing to advise on practically any problem. Fortunately, the state registration boards now require engineering registration for those offering to undertake highway, traffic, parking, and related economic studies."

Smith always has been interested in technical and professional society activities. Back in school, he was active in AIEE, and continues to maintain membership even though his type of work is not electrical. He also joined ASCE, serving on a number of committees and as chairman of the Committee on Traffic Engineering, which is a part of the Highway Division. He is a member and has served the Institute of Traffic Engineers as national president; was chairman of the Department of Traffic and Operations of the Highway Research Board and is now a member of its Executive Committee; and is a director of the Eno Foundation for Highway Traffic Control.

Other professional activities include membership in: National Society of Professional Engineers; New York State Society of Professional Engineers; South Carolina Society of Professional Engineers; South Carolina Society of Engineers; American Society of Safety Engineers; American Institute of Consulting Engineers; National Defense Executive Reserve for Public Roads; and the National Joint



Half of Ljungstrom rotor is lowered into place at Philadelphia Electric Co.'s new Eddystone Station. When heating element baskets are fitted into the rotor chamber, this unit will provide 201,100 sq. feet of heat transfer surface and will weigh about 535,000 lbs. It will be one of four air preheaters serving a 325,000 KW unit. Two such boiler units are presently being installed.

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Air Preheater also shows lively, consistent interest in their *factory* service to customers. For example, when a midwest customer recently ordered emergency replacement elements, Air Preheater's traffic depart-

ment investigated the cost, speed and control of all commercial shipping methods. In the circumstances, regular trucking would take too long, rail delivery was impractical, other methods prohibitively expensive.

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CASE HISTORY NO. 101

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CATALOG 1010 gives further details; shows applications in many fields. Write —



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Committee on Uniform Traffic Control Devices.

"I enjoy participating in the activities of organizations of this type, and I feel every engineer owes something to them. A consulting engineer trying to get started makes friends and establishes relations that mean much to him in furthering his professional career. No client wants to engage an engineer who is unknown to his fellow engineers. The recommendation of a professional colleague is most valuable, and the best way to establish yourself within the profession is through participation in technical and professional societies."

As head of a still relatively young firm, Smith feels that there are a number of immediate problems confronting the profession of consulting engineering. One of these is the matter of competitive bidding and the difficulties it creates for consultants in obtaining traffic and transportation jobs. "It should be the responsibility of every consulting engineer to guard against efforts to make the profession 'nonprofessional'."

Another is the hurling of charges and counter-claims now going on as to whether consultants really are filling an important niche in the field of engineering. He views these claims and counter-claims as "most unfortunate" but feels that time undoubtedly will establish the consulting engineer as one who fulfills a justifiably important role in the over-all engineering field.

A third problem, as Smith sees it, is that of staffing. But with the training of qualified personnel in increasing numbers, he believes that this one is being eased to a great extent.

Smith is also optimistic over the growing trend of coordinating highway traffic matters with planning, which "offers great encouragement for orderly future development."

Smith's firm is one of the largest in the country specializing in traffic engineering on a nationwide basis. And although traffic engineering is a specialty field, there are specialties within the specialty.

Diversity of Projects

The firm's projects, for example, range from feasibility studies for bridges and tunnels to access, circulation, and parking layouts for shopping centers; from site selection and finance studies for parking garages to transportation surveys of metropolitan areas; and from toll studies to major route location projects. Geographically, the jobs have ranged from Canada to the Caribbean.

In Florida, where sun and sand are drawing thousands — along with their thousands of cars — Smith has been kept busy. The Florida State Road Department hired him to analyze the mounting traffic tangle in metropolitan Dade County (Miami), an area especially susceptible to an expand-

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ing automobile population. Out of the extensive studies has come a major highway plan that ultimately will give this growing resort city 41 miles of expressway system with a loop of the downtown area. The program was approved in its entirety and work is well under way on the more than \$200 million dollar project.

"We planned this system so that it would offer good access to the downtown area, and thus serve both local and through traffic. We think it is an ideal system, because it serves practically every important traffic movement in the area," Smith pointed out.

Miami hopes to finance part of Smith's expressway system with Interstate and regular highway funds; part with local bonds; and part through a toll arrangement. If the voters approve, it will help solve the problem of paying for expensive intown real estate — a problem facing most urban expressway builders throughout the nation.

"The greatest recommendation for toll-financing parts of the system is that it will make possible completion of a substantial part of the entire program now. Otherwise, much of the system might be years in the making," Smith points out.

Traffic Study in Virginia

In Virginia, Smith has tackled a problem that has been facing the traveling man since another Smith first stood on the shores of the Chesapeake Bay with the Indians as his companions. The problem: the advisability of building a crossing connecting mainland Virginia at Norfolk with its eastern shore across the bay.

For years the Chesapeake has been spanned by ferry service. But as the volume of highway traffic increased, Virginia planning officials began to look to more concrete means of tying together this bisected portion of the state. They came up with an ambitious plan for a 17-mile bridge and tunnel crossing that would cost some \$148 million dollars. Smith was hired to determine whether future traffic over such a crossing would warrant the sizable expenditure.

When the project becomes a reality it will put Norfolk on the fastest route between New York and Florida. According to some experts, it will make the port city of Norfolk the largest East Coast metropolis between the Bronx and Miami.

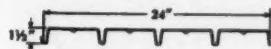
A sizable portion of the firm's work relates directly or indirectly to the Interstate Highway program. "The Interstate program answers a real need," Smith says, "but as it progresses, it focuses greater attention on the traffic and parking problems of the cities which are to be connected by the system. They face the herculean task of coping with changing traffic patterns and of providing terminal fa-

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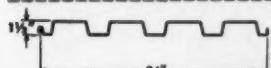
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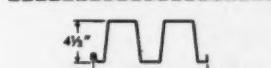
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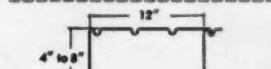
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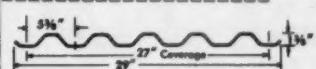
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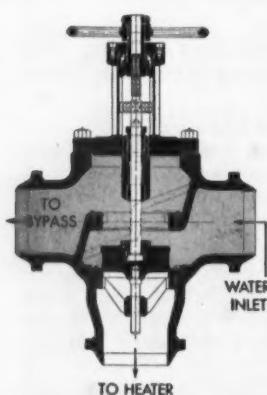
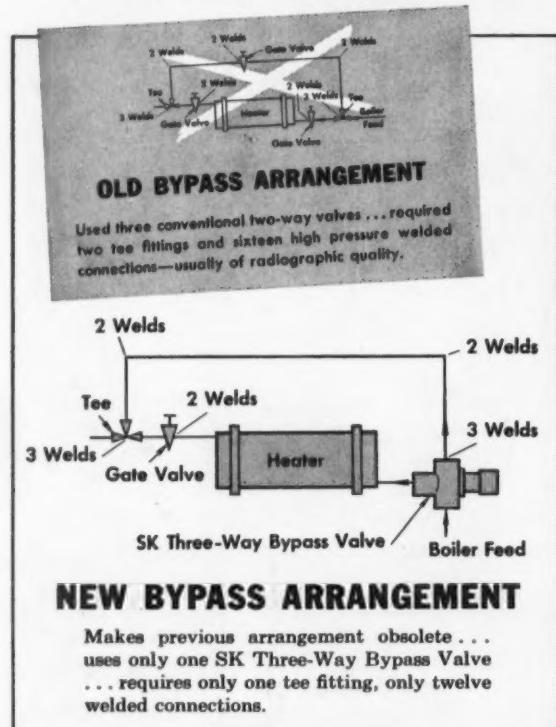
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cilities to accommodate expressway traffic after it reaches the city limits. The automobile has little value if routes of travel alone are provided. The terminal is essential."

Motorists in a number of mid-western cities, like their brethren in the East, have had their jangled nerves soothed through the use of Smith-engineered traffic remedies. The firm recently completed comprehensive traffic studies for Kansas City and St. Louis, Missouri, aimed at helping satisfy traffic needs for the next 20 years. On the West Coast, where mass transportation is almost an unknown quantity, the firm developed master expressway plans on a county-wide basis for rapidly-growing Alameda and Riverside Counties, California.

Smith's engineering studies are not confined to the expressway or the downtown traffic jam. He is of the belief that wherever and whenever you get a lot of people moving around on a lot of wheels you are bound to come up with some kind of traffic problem. Consequently, his firm does a great deal of work for traffic-attracting businesses—shopping centers, industrial parks, garages.

Traffic Research Projects

More in the area of research, Smith and his associates have done studies for the Outdoor Advertising Association of America to formulate a means of measuring and evaluating the market values of highway traffic; for Esso Standard Oil Company concerning a more scientific approach in the selection of site locations for service stations; for U. S. Steel, a survey of materials used in traffic signs and supports; for the Bureau of Public Roads, a study to determine the effects of the accelerated highway program on public and quasi-public uses.

The firm also has conducted extensive research in perfecting a technique for synthesizing travel patterns based on land use. Smith believes that the new technique "opens a new and challenging area for statewide studies aimed at developing long-range road needs and relating the highway transportation system of the future to the over-all economic potentials of the state."

Smith divides his time between his principal offices and his many field projects. His personal office is very often an airplane seat. Last year he flew a total of about 250,000 miles. "I'm one of the few engineers," says Smith, "who has callouses on his stomach from fastening and unfastening a seat belt."

Along the route of his pressure-packed travels, Smith manages to work in a few speeches and to prepare technical papers for professional meetings.

In his spare time he reverts to his Southern heritage, taking an occasional relaxing weekend on his South Carolina farm where the one horse-power creates no traffic problem.

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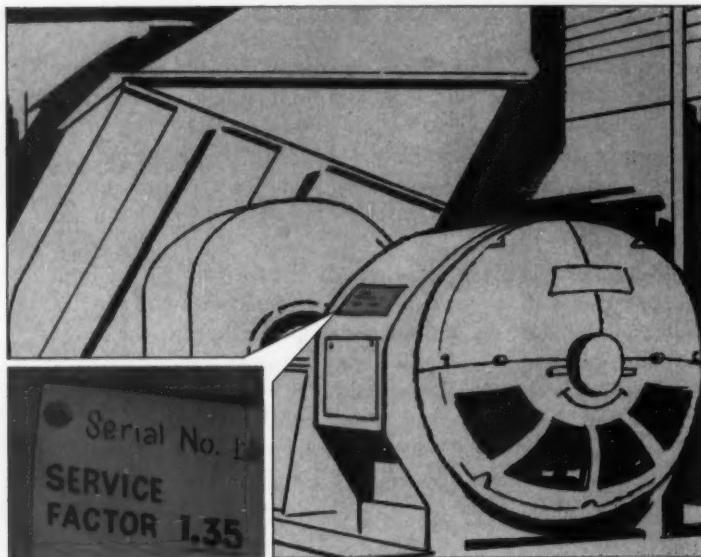
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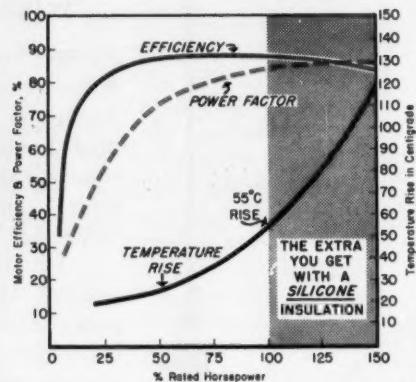
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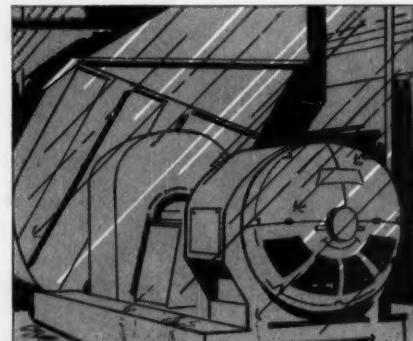
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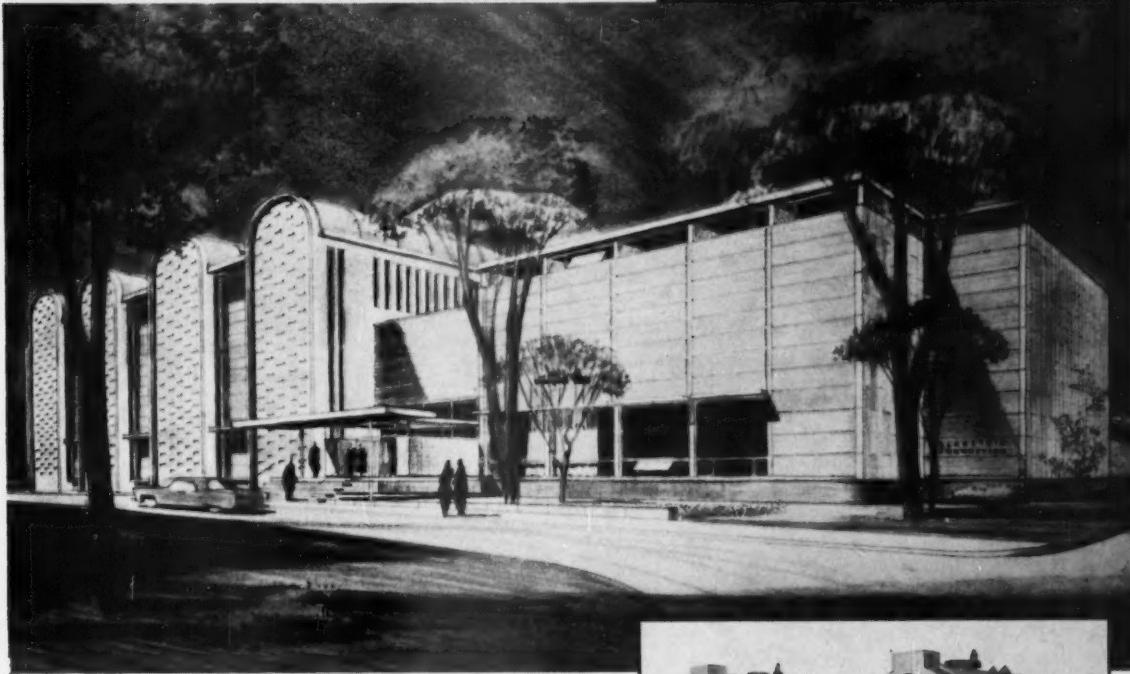
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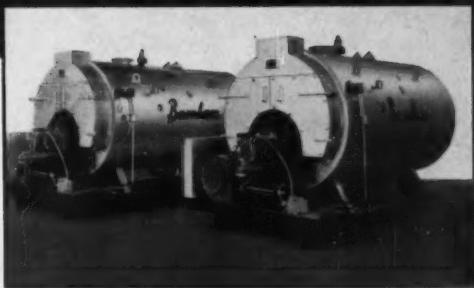
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From the Editor's

Tranquil Tower

ON FIRST READING the December Report of the Comptroller General to Congress, prepared by Mr. George Staples, Associate Director of the Civil Accounting and Auditing Division of the General Accounting Office, we were much angered by his attack on the use of consulting engineers on Federal-Aid highway projects. (See "Field Notes," page 145.) We pounced immediately on his statement, "If all required engineering services were performed by the respective state highway departments, there would be no element of profit in highway engineering cost . . ."

Here is a responsible official in the office of the Comptroller General, the independent auditor reporting only to Congress, who clearly states that he finds it improper for private enterprise to make a profit on government projects. Ah, we thought, here we have it—capitalism's guts are being eat by a fox hid beneath its shirt.

On further study, we changed our mind. We had not read the whole sentence carefully enough. It continues, ". . . and, by regulation, state highway department overhead is not a highway cost eligible for Federal participation." Here is the key to the whole business. We had been so agitated by Mr. Staples' objections to a profit for consulting engineers that we had missed the meaning of the second half of his sentence.

It is not, it turns out, an aversion to profit that motivates Mr. Staples in his fight against consulting engineers. His is no bureaucratic plot against private enterprise; here is nothing, in fact, but innocent stupidity. Mr. Staples, honest-to-gosh, is just trying to save the Federal government's money.

To understand what Mr. Staples is driving at in the last half of his sentence, we must keep in mind that the Interstate Highway Program is financed 90 percent by the Federal government, 10 percent by the states. The states' expenditures for consulting

engineer fees are paid under this 90-10 arrangement, while, in contrast, the 90-10 formula applies only to the *direct* engineering costs when the work is done by state highway departments. All indirect costs then fall entirely on the states, and, as Mr. Staples puts it, "We are not concerned with the overhead of state highway departments."

Now, Mr. Staples is a Federal man, and he is looking at this thing through Federal eyes. Only the Federal cost is toted-up in the General Accounting Office, and from the Federal point of view, the use of state highway engineers saves the Federal Taxpayer's money. If, at the same time, it costs the State Taxpayer twice that much, that is none of Mr. Staples' concern. That the two taxpayers, Federal and State, are the same means nothing in the General Accounting Office. This is a delicious example of myopic economics.

It is unlikely that all this can be explained in the General Accounting Office rapidly enough for it to have any effect on this generation. The answer is for Mr. Tallamy or Mr. Armstrong, of the Bureau of Public Roads, to ask Mr. Campbell, the Comptroller General, to tell Mr. Staples that the truth is out. He has blundered. His report will bring about exactly the opposite of its intentions. More of the states soon will get wise, as Pennsylvania already has, and will realize that when highway engineering is done by consulting engineers, Federal funds pay for 90 percent of the full engineering cost. When engineering is handled by state highway engineers, only 30-40 percent of the cost comes out of Federal funds.

Even where the state highway department is reluctant to give up its personnel expansion program, state legislators are going to be asking their Highway Director why he is willing to accept less Federal money than goes to the states that use consulting engineers. Mr. Staples has, it seems, inadvertently given the states the best of all reasons for using engineers in private practice.

This amounts to hanging the Comptroller General with his own rope, but such a public execution will be a pleasant spectacle for consulting engineers. ▲▲



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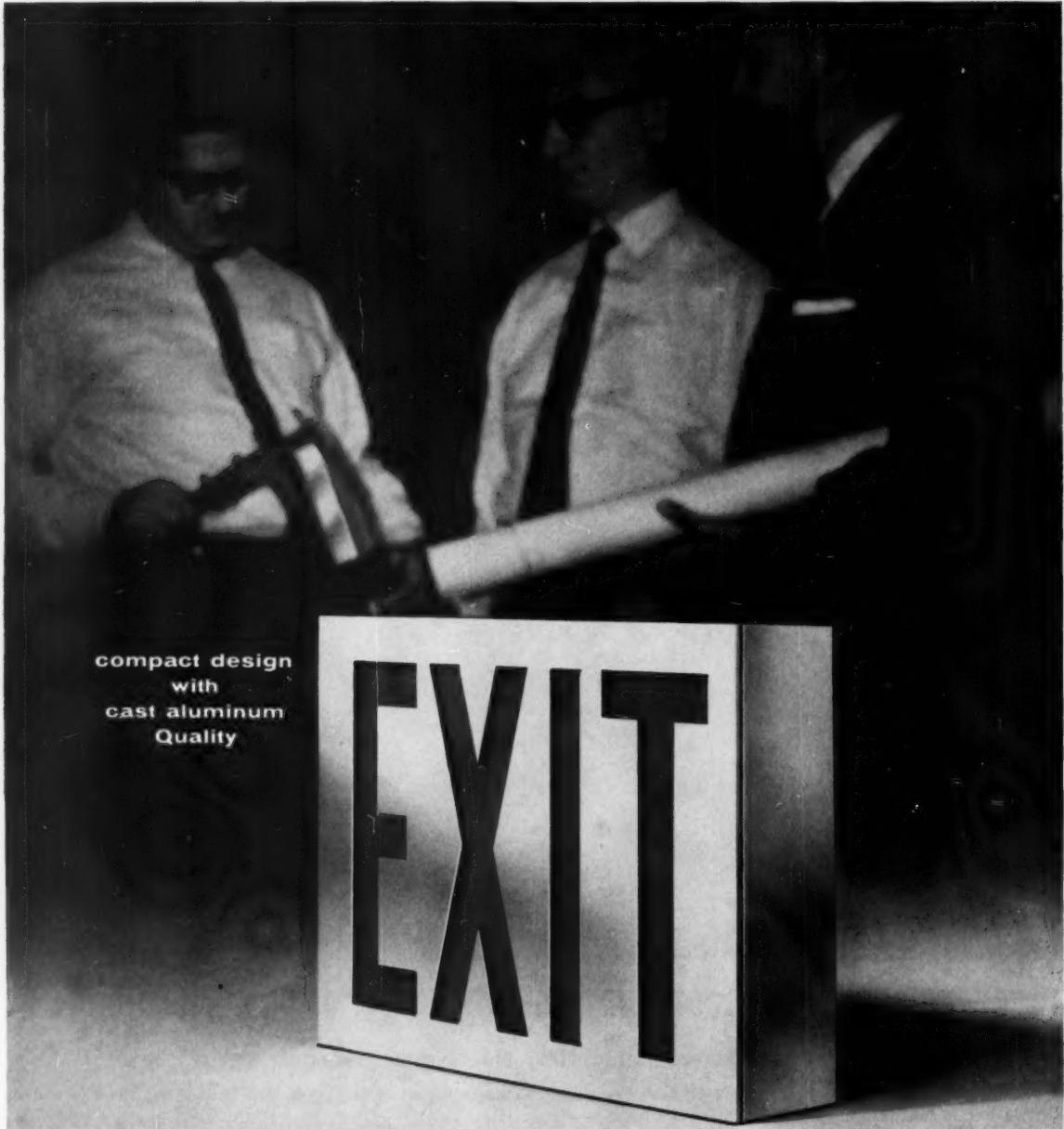
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Readers' Comment

Dear Mr. Comptroller General

Sir:

Attached is a copy of a letter addressed to Mr. Joseph Campbell, (printed in full on page 174) Comptroller General of the United States. I believe the letter to Mr. Campbell is self-explanatory with respect to our views concerning the General Accounting Office reports which they have issued relating to the use of consulting engineers in the Federal-Aid Highway Program.

While we as consulting engineers have selfish motives in seeking to have the Federal and state governments utilize the services of consulting engineers, we have another interest equally compelling in bringing this matter to your attention. We sincerely believe that the use of consulting engineers, whose services are obtained by contract arrangements, is in the best economical interests of both the Federal and state agencies from a taxpayer's standpoint. Our basic concern is that the true costs of the government agencies performing their own engineering services be fully disclosed to the public so that fair comparisons of these government costs can be made with established contract awards made for consulting engineers' services.

The continued practice of issuing ex parte statements by government officials that Civil Service engineer-

ing is cheaper and more efficient than that rendered by engineers in private practice should be proven by facts and not unsupported opinion. We believe that whatever influence you can exert toward obtaining full disclosures of true costs of government activities will be in the best interests of the taxpaying public.

Ralph M. Westcott, President
Consulting Engineers Council

Misplaced Credit

Sir:

We were most surprised to find a credit line indicating Fabian Bachrach as the photographer for the four-color photograph of Mr. Adolf H. Koebig, Jr., which appeared on the cover of the February issue of CONSULTING ENGINEER.

We distinctly recall photographing Mr. Koebig for this cover portrait, and we distinctly recall mailing this color transparency to you. We can only assume, therefore, that this is our photograph and that the mistake is not in us but in you and your printers. We would appreciate your calling it to the attention of your readers that it was the Curtis Studios rather than Fabian Bachrach who was responsible for this original four-color photograph.

Mrs. Beth Curtis Magnuson
Curtis Studios
Los Angeles, Calif.

• THE FOUR-COLOR PHOTOGRAPH OF
MR. KOEBIG WAS INDEED TAKEN BY
CURTIS STUDIOS. OUR APOLOGIES.

The Component of Experience

Sir:

I think your definition [of "consulting engineer"] lacks the important qualification of *competence* which is covered as the third item in the list of Aims and Objects set out in the Professional Rules and Practice and Scales of Fees of the Association of Consulting Engineers (London), from which I quote:

"A Consulting Engineer is defined in the Articles of Association as a person possessing the necessary qualifications to practice in one or more of the various branches of Engineering who devotes himself to advising the public on engineering matters or to designing and supervising the construction of engineering works . . ."

Admittedly, under your definition an Engineer would have to meet up to a certain standard of qualification before he could be "legally" engaged, but I think the standard required for official registration in some States would not be accepted by many member-associations, any more than membership of any of our parent bodies *alone* would be accepted by the ACE (London). Such qualifications are, of course, basic but do not have the component of "experience in the profession" which is required by our members to ensure their competence.

Another point — surely the hallmark of a qualified consulting engineer is maintenance of membership in a recognized association of consulting engineers.

Julian S. Tritton, President
International Federation of
Consulting Engineers (FIDIC)
London, England

Architects Reluctant

Sir:

I was interested and pleased with the article by Donald R. Goodkind in the February 1960 issue entitled "Why Let the Low Bidder Fix Your Fee?"

This has been my preaching and my thinking concerning engineering fees as well as architectural

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fees for a long time, and Mr. Goodkind should be commended for pinpointing the problem.

In my own practice I have been negotiating lump sum fee contracts on the civil engineering part of my practice for at least 15 years, and practically all of my clients prefer this method. I have not, however, been able to sell my architectural clients on this method except in one or two cases, but some of them are coming around to thinking of a lump sum type of fee for their architectural work. However, up to date, they are at a loss as to how to convince their clients of its desirability. Many of them are also fearful of their own estimates for cost of their work unless they have the benefit of an established preliminary set of plans for the project completed and approved.

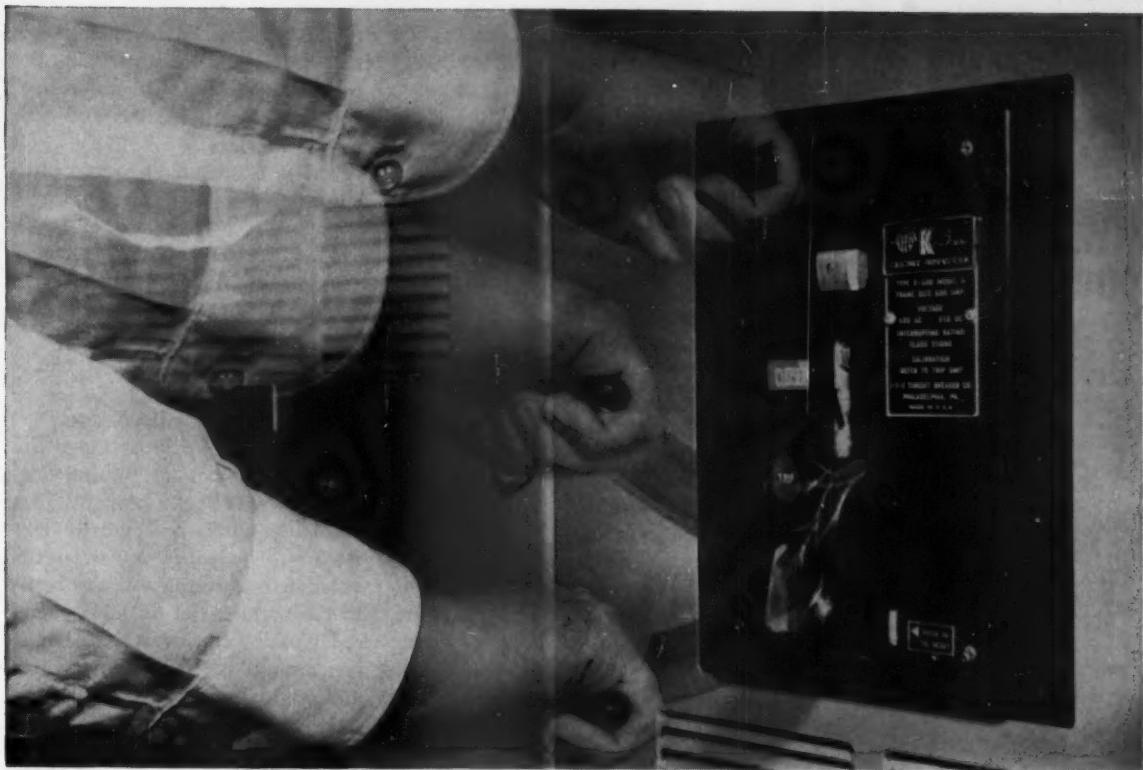
Orley O. Phillips
Phillips-Carter-Osborn, Inc.
Denver, Colorado

Still No Image

Sir:

In your article on page 88 of the January 1960 issue, you say, "Unlike other professions, the consulting engineer has created no public image." Then you demonstrate the fact that you have no image of consulting engineers by referring to them as "the principals and partners who are the heads of their firms," and as the "4000 top men from as many firms" and on page 90 they are referred to as "men who are in private practice." In other words, your image of a consulting engineer is not that of a man engaged in consultation with someone on the proper solution of an engineering problem but of a man who operates a business of selling engineering services.

For a couple of years I was a member of the California Association of Consulting Engineers and attended most of the luncheons and meetings during that time. I do not remember any program which dealt with "consulting engineering." The programs, it seemed



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to me, were devoted entirely to the business of operating an office; with the ethics of bidding, kinds of contracts, pay schedules, side benefits for employees, methods of preventing other firms from stealing competent employees, and methods of reducing the cost of operating an office. I have no engineering employees so I dropped out. I do not know why such activity is called "consulting engineering."

A group very close to operators of engineering businesses are the manufacturers. A notable group of electronic equipment manufacturers, such as Varian, Ampex, and Hewlett-Packard, have been organized near Stanford.

There is much more real "consulting engineering" being done in these plants than there is in the commercial engineering offices which are engaged principally in turning out routine designs. Of course, there is some high class consultation furnished by these commercial engineering offices.

George L. Sullivan
Consulting Engineer
Santa Clara, California

"Palmer & Baker" for "PBQ&D" . . .

Sir:

May I call your attention to an error in your February 1960 issue of CONSULTING ENGINEER.

On page 110, in the article entitled "Ten Projects Financed by the World Bank," the notation for the Ecuador Port Project states that Parsons, Brinckerhoff, Hall & Macdonald (now Parsons, Brinckerhoff, Quade and Douglas), New York, New York, is the consulting engineer. This is incorrect.

The contract plans and specifications for this port, including the new port itself, the Estero Salado ship channel to the Gulf of Guayaquil, and the Salado-Guayas canal and lock, were prepared by Palmer and Baker Engineers, Inc., of Mobile, Alabama. Contract was awarded to Compania Raymond, S. A., a subsidiary of Raymond International, after spirited interna-

tional bidding. Palmer and Baker Engineers, Inc., are supervising the construction, which is under way, and furnishing materials and soils testing services.

The firm you credit has no present connection with this project.

W. H. Smith
Vice President & Chief Engineer
Palmer and Baker Engineers, Inc.
Mobile, Alabama

Author's Rebuttal

Sir:

Your review of my book *Engineering Economics for Professional Engineers' Examinations*, published by McGraw-Hill Book Company, Inc., is highly unfair and grossly misleading. The entire review is devoted to one chapter of the book, to the exclusion of all other material. Nothing whatever is mentioned concerning the many distinctive and original features in the presentation of engineering economics that appear in this text. Many engineers lack familiarity with both the nomenclature and substance of business finance, and find this fact a serious impediment when applying for licensure. This book is designed to meet the great need that exists for a suitable text on the subject, one adapted to the requirements of the licensing examinations.

Many review books in engineering economics are in essence mere catalogues of mathematical formulas, and are therefore valueless to the examinee when, as frequently occurs, he is confronted with a problem that does not lend itself to solution by formula. This text, on the other hand, by developing the basic theory that underlies engineering economics, enables the reader to solve any type of problem whatsoever and to understand the true meaning of the solution. It also presents very simple methods of verifying the solution to a problem, a practice that makes the book ideal for use in both a review course and a self-study program.

Max Kurtz, P.E.
Brooklyn, New York



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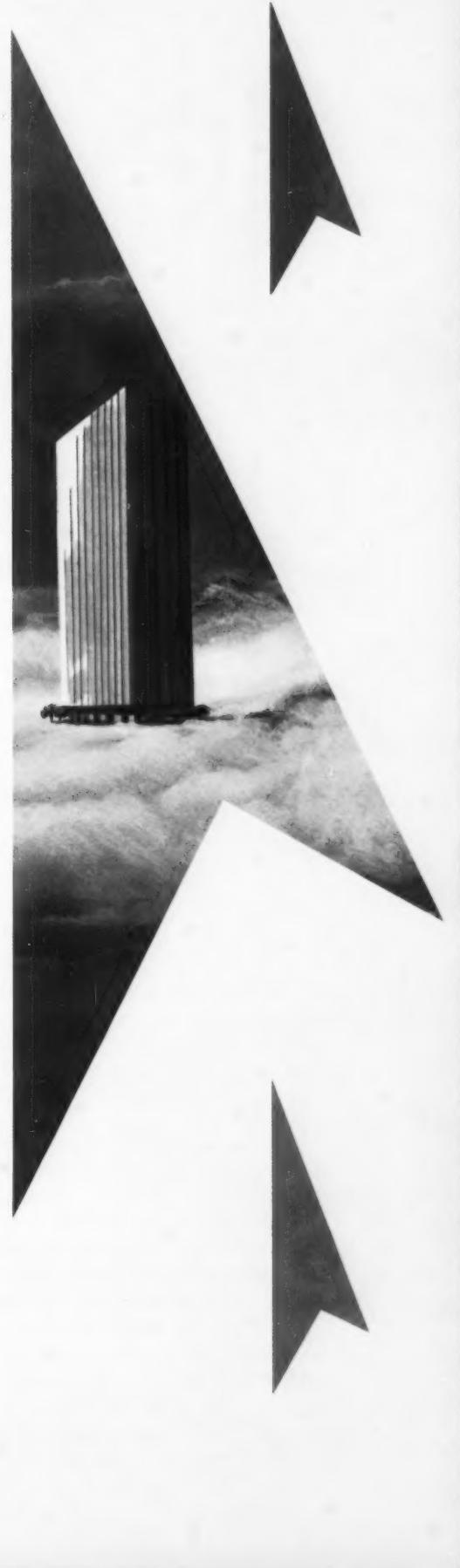
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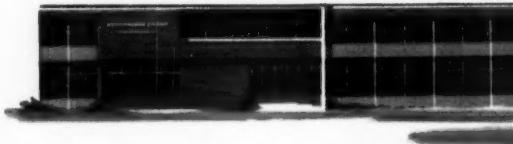
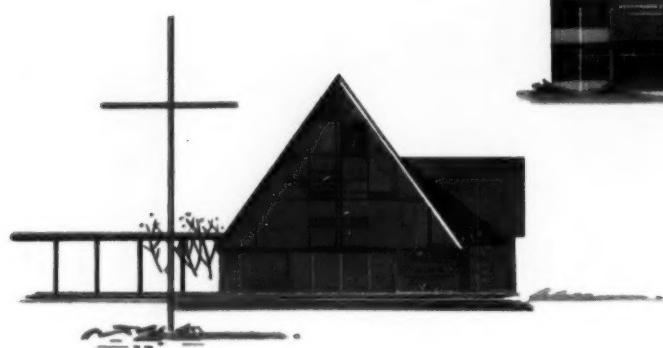


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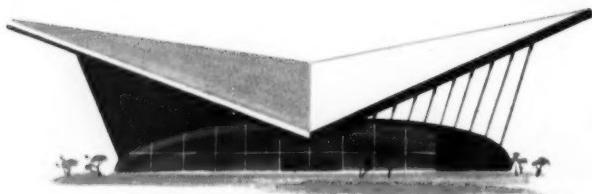
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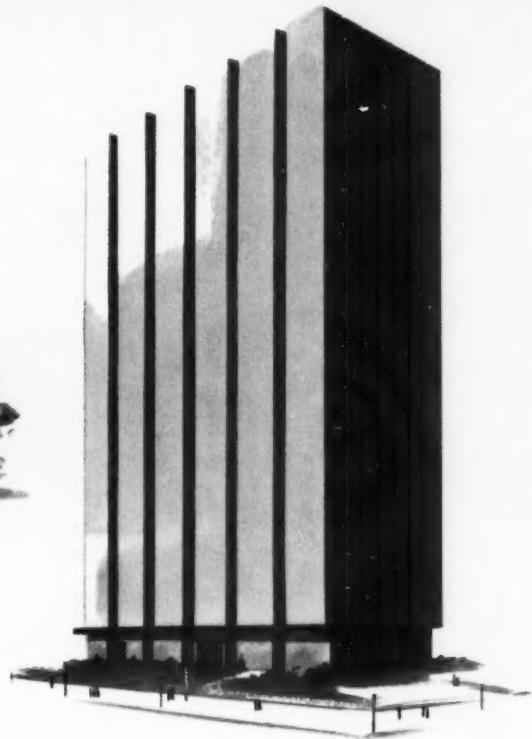


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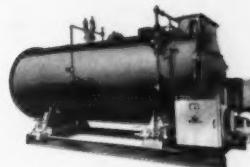
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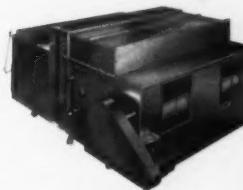
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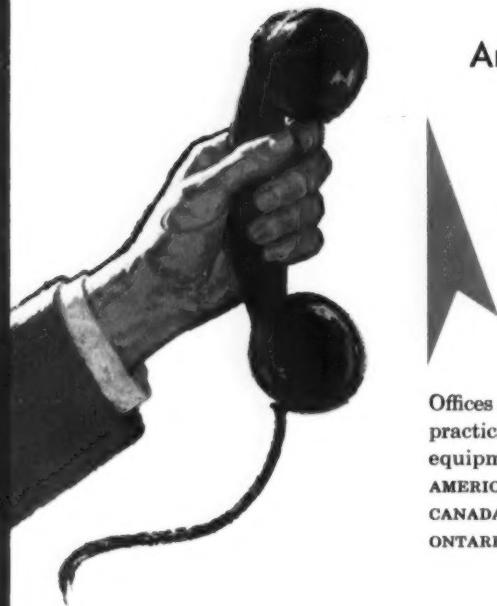


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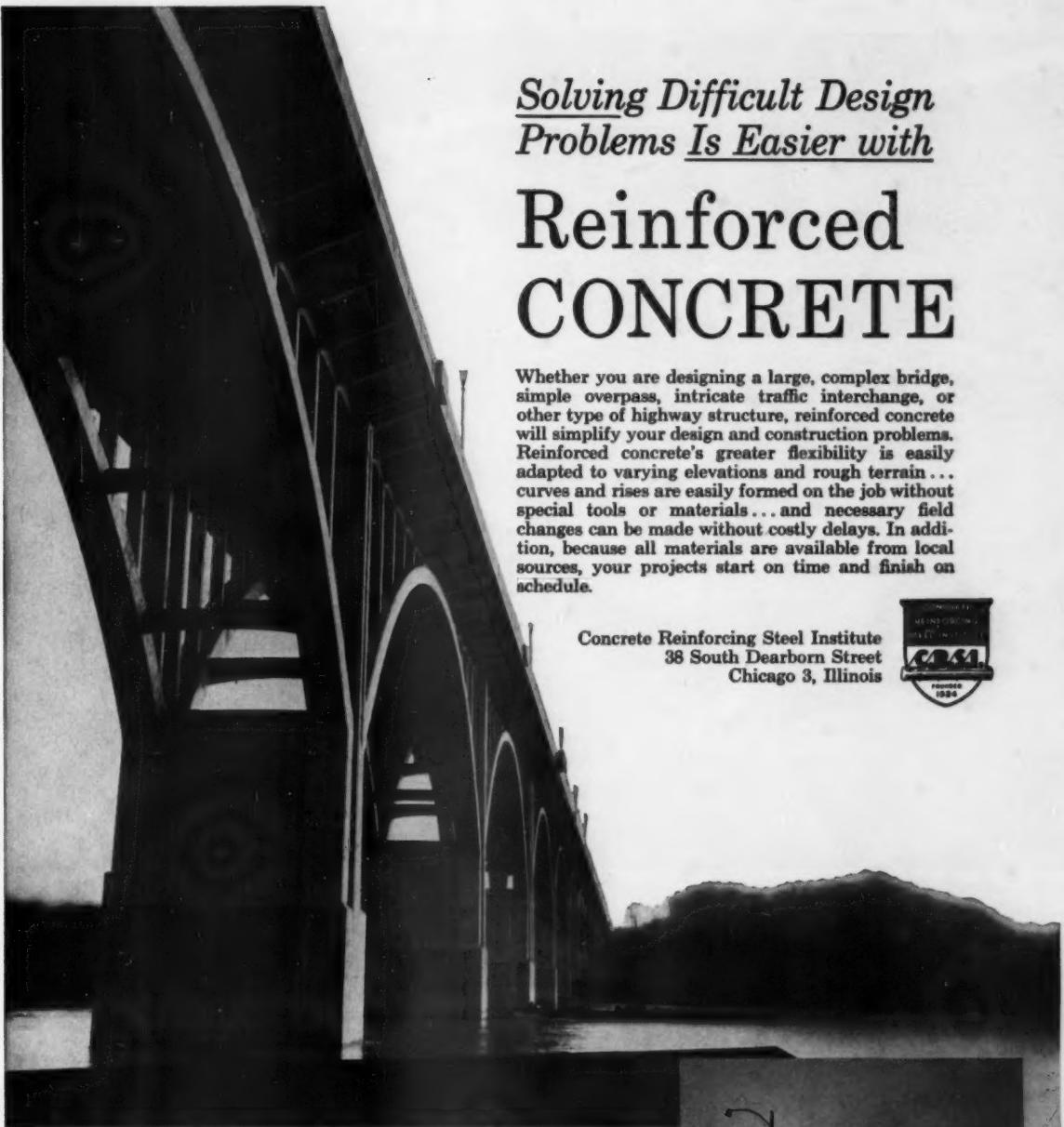
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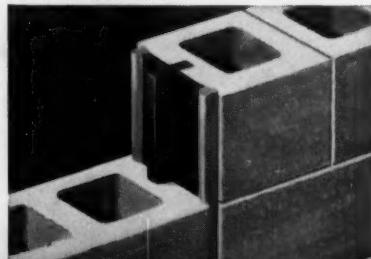
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**The Strength
of the
Opposition**
(page 88)

J. L. Breese is a consulting engineer of Santa Fe, New Mexico. Not only that, he is quite a clever fellow and a fine writer as well. We have not, in a long time, read an article that so fascinated us in manuscript. In reading of his dilemma in dealing with small projects, one wavers — is this man serious? Is he pulling the reader's leg? The problem is a serious one, but how serious is Breese about his Profit Erosion Curve? We carefully checked his calculations, considered the gravity of the problem, and decided that there is nothing wrong with mixing a little yeasty levity in a dough that all too often lies heavy and unrisen in the crock. We like Breese's Law and anticipate its full acceptance by the profession. Test it on your next fee and see.

**Psychological
Testing**
(page 105)

No ball team manager would feel very confident going into a game against an unscouted opponent. Or as Senator Humphrey once put it, "When I go into a campaign, it is more important for me to know my opponent's platform than it is for me to know my own." Yet, consulting engineers have been facing continuously increasing competition from government engineering departments for months and have made next to no effort to determine what strength these opponents claim for themselves. True, some engineer organizations (and some disorganized engineers) have been trying to determine the cost of consulting engineering on certain types of government projects and have been trying to get reliable figures showing true costs of engineering when done by government employees. But it does not seem to have occurred to anyone to find out what government engineers (outside of California) say about their own costs. We thought it would be interesting to find out. The cost figures these departments claim to be true are, one may presume, the same ones they would use if called upon to testify before a committee of Congress. It can do consulting engineers no harm to know what these claims are so that they can be dealt with intelligently. To find out what one group of government engineers had to say about cost, we wrote to every state highway department and asked that they supply us with comparative costs for equivalent engineering work when done by consulting engineers and by state highway engineers. We got answers from almost half of them. Some are devious; some are simply stupid; but most seem sincere. The figures offered are suspiciously low by at least a half, and it is reasonable to suppose that these figures, in most instances, represent only direct costs, or at most, direct cost plus a fraction of true overhead. But it must be kept in mind that these answering letters were written by engineers — professional men who belong to the same national technical and professional societies as consulting engineers. These engineers are honorable men, and they believe their figures. They are sincerely convinced that their departments can handle engineering at less cost to the taxpayer than can consulting engineers. These are the figures they will present if called upon to testify. These are the figures consulting engineers will be asked to refute. Are we ready to refute them?

**The Small Job
Dilemma**
(page 116)

Here lately it has been considered quite U to scoff at the organization man, particularly the way his organization goes about testing employees and potential employees to make sure they fit the organization's mold. It is claimed, for example, that Sears Roebuck will not hire an executive who appreciates the work of any artist more abstract than Maxfield Parish. There are also a myriad stories of million dollar insurance salesmen rejected by tests designed to uncover their retrogressive antagonisms. It is true that this business has been carried too far, and there are many industrial psychologists who have convinced their



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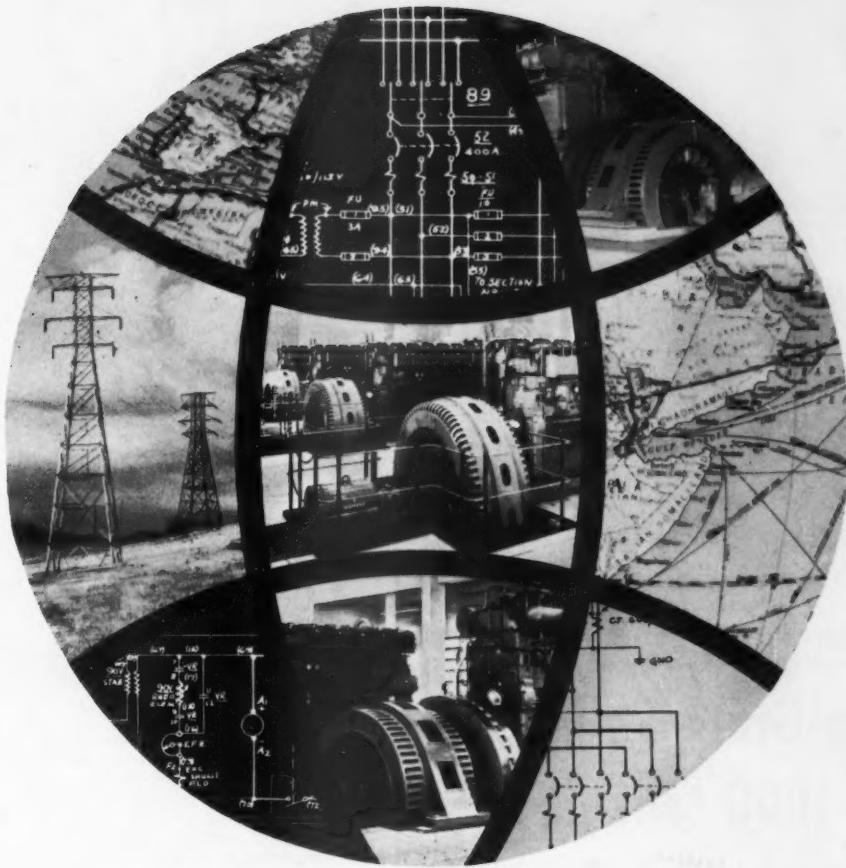
clients (and sometimes even themselves) that they can find, through their test procedures, the precise answers to questions never asked. But the whole concept cannot be tossed aside because some spots are spoiled. Basically, the fruit is good. Yet, consulting engineers, generally practicing through relatively small firms, have felt that psychological testing is not for them. Actually, it is, and the small firm may get more for its money than the great impersonal organization. Bennett Coulson, a consulting engineer of Houston, gave it a try. His article tells of his recent experiences with the program administered for his firm by an organization of consulting psychologists.

Early American Tunnels (page 110)

Regular readers of CONSULTING ENGINEER are familiar with the work of Richard Sanders Allen, who has written several excellent articles for us on the history of this country's bridges. Allen's new article takes us under instead of over. He deals with tunnels. While we still are inclined to associate tunnels with railroads; most of the tunnels yet to be dug probably will lead major highways under great mountains or streams. It was not always so. The earliest tunnels in this country preceded even the railroads; they were part of the canal era, and tunnels were themselves waterways rather than routes under them. According to Allen, our first tunnel was started in 1818 to take the Schuylkill Navigation Canal through a 40-ft ridge in eastern Pennsylvania. But this is no place to steal his story . . .

Designing Ocean Outfalls (page 96)

The design of an ocean outfall for disposal of sewage amounts to more than running a long pipe out into the water, especially if the bordering beaches are popular playgrounds, and little is known about the effects of tides and currents. Improper engineering calculations could upset the boys at Muscle Beach. R. R. Alvy, assistant to the vice president of Holmes & Narver, Los Angeles, is fully qualified to speak of the problems inherent to ocean outfall design, for he has been recently associated with the huge Hyperion Project outfalls for Los Angeles. In his near-definitive article he discusses every engineering aspect of outfalls from oceanography to metallurgy and not only explains the influential design factors but clearly indicates the proper approach to a solution. Alvy's article is, you will agree, the type *properly* referred to as "a contribution to the literature," and warrants the attention of any consulting engineer who may face a similar design problem someday. ▲▲



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20-YEAR ROOF BONDS—obtainable on Granco Roof Deck with 1" insulation board.

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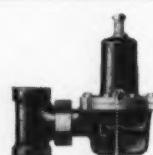
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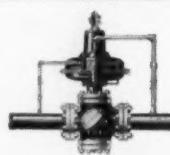
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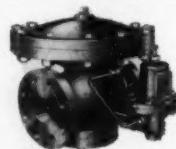
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ASCE Professional Practice Committee Offers Revisions of Code of Ethics

THE PRINT was scarcely dry on an article in the January issue of *Civil Engineering* ("An Interpretation of the ASCE Code of Ethics") before the Society's professional practice committee came up with a revision entitled "Proposed Code of Ethics" and "Redraft of Rules of Professional Conduct." This proposed code, which may or may not be accepted by the Society, is a considerable improvement over the current code of ethics and its accompanying rules.

While there are a number of lesser changes, the two principal revisions involve the elimination of the older Item 5 which forbids competition by reducing the usual charges in attempting to underbid after being informed of the charges named by another engineer—and some important changes in the item having to do with competitive bidding on a price basis.

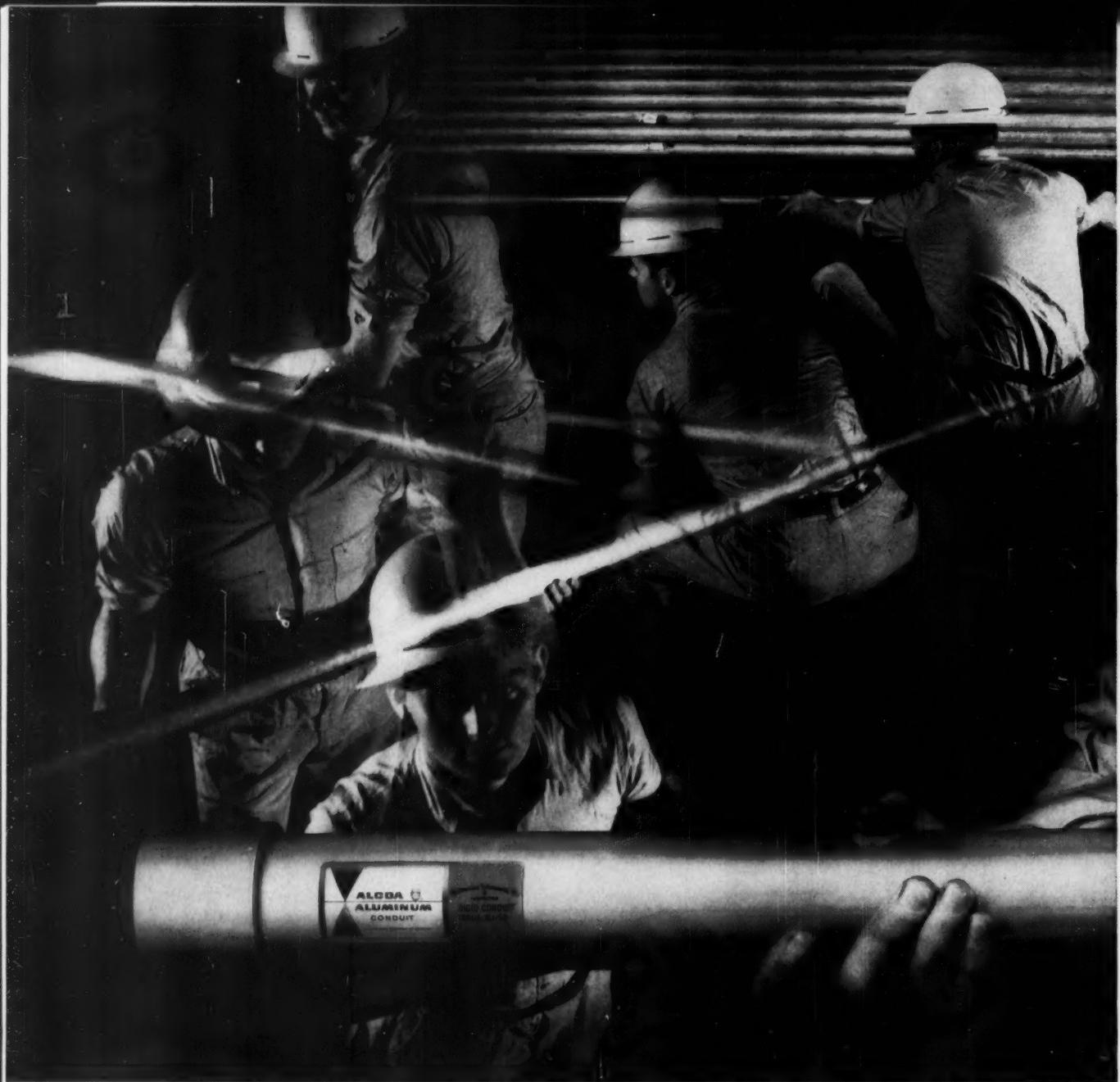
The elimination of the old Item 5 does not mean that this type of activity is now condoned. Instead, it is obvious that the committee feels that this already is covered under the competitive bidding item and therefore only need be brought out in the accompanying explanatory rules.

The really vital change that is suggested here is the elimination of the old Item 4 which reads, "To invite proposals for the performance of engineering services or to state a price for such services in response to any such invitation, when there are reasonable grounds for belief that price will be the prime consideration in the selection of the engineer." To substitute for this, the committee proposes, "To invite or submit priced proposals under any conditions that constitute price competition for professional services." Certainly, this new proposal

is a great improvement over the old item in the code, for despite the intentions, the actual wording of the old Item 4 was so poor that it was almost an invitation to obviously unethical practice.

Few will complain about the newly proposed item. However, there will be some complaint about one of the items of explanation referring to this revised part of the code. The suggested "Redraft of Rules of Professional Conduct" includes the following: "A statement including reference to a recognized fee schedule such as in ASCE Manual 38, or an approximate range of prices if requested for budget purposes prior to initiating negotiations for specific scope and fee, is not considered a priced proposal. Any stated range in prices shall be wide enough so that it cannot be construed as a . . . priced proposal."

The intent here may be good, but, again, the Society will be leaving itself wide open if it adopts this statement. It leaves a loophole for price bidding big enough to drive a major project through. The professional practice committee (and whatever other committees or boards are involved in the study and approval of this proposed code and the redraft of rules) would do well to take a hard look at this particular rule as written here and eliminate it completely. It should be obvious that such a rule will only become an excuse and an aid to the unethical and will in no way aid or assist the innocent. ASCE should not, in correcting one mistake, fall into another somewhat similar one. Other than this particular point, however, the newly proposed code and its redraft of rules seems excellent—certainly it is an important improvement over the one it proposes to replace. ▲▲



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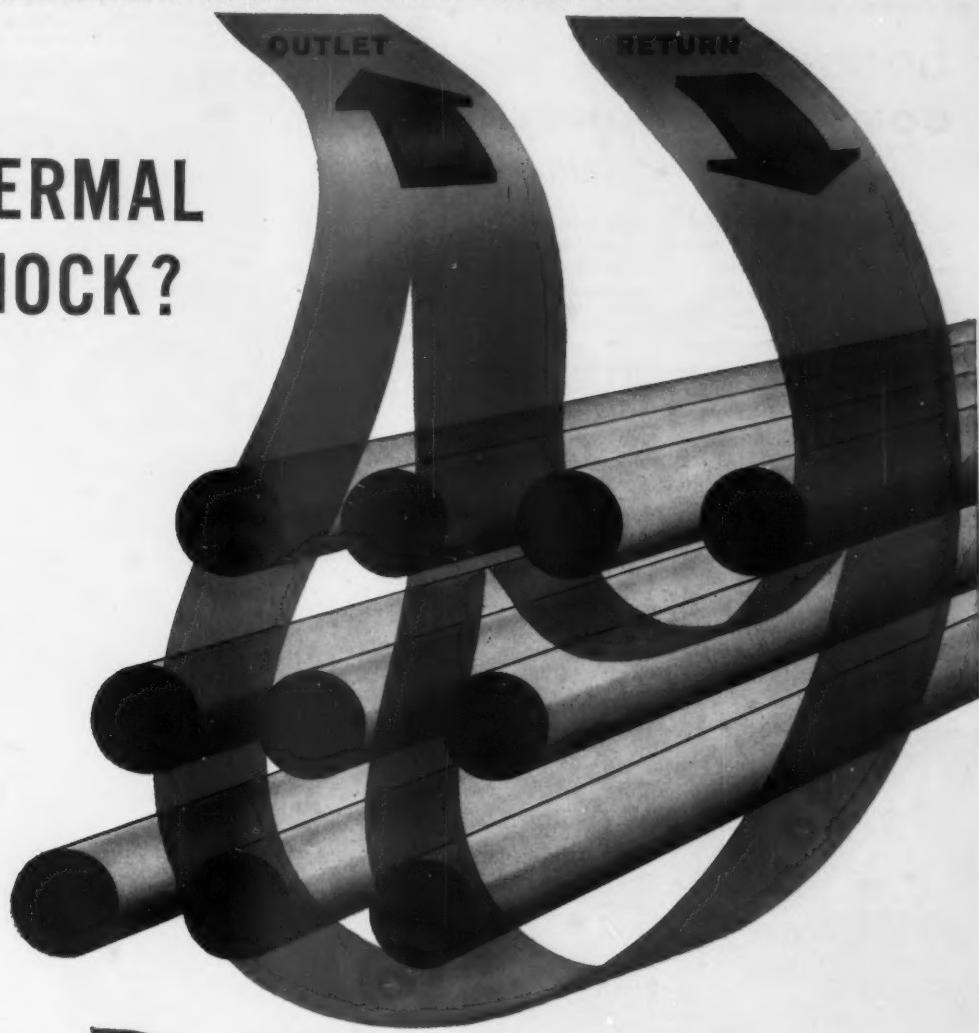
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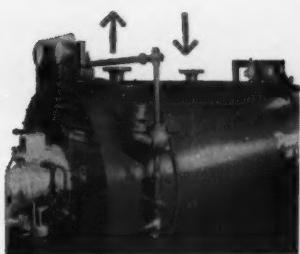


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MARJORIE ODEN,
Eastern Editor

ACCORDING to a report in *The Oregon Consulting Engineer*, nominees for national officers of Consulting Engineers Council will be announced shortly. A "usually reliable source" indicates the following slate: president, Hueston M. Smith, of Smith, Hanlon, Zurheide, Levy, Inc., St. Louis, Missouri; first vice president, Harold King, of King, Benioff & Associates, Sherman Oaks, California; second vice president, Fred K. Steel, of The F. K. Steel Company, Great Falls, Montana; treasurer, Lester L. Bosch of Bosch & LaTour, Cincinnati, Ohio; and secretary, George J. Toman, Consulting Engineer, Mandan, North Dakota. The slate will be presented to the membership at the annual spring meeting in Gearhart, Oregon on May 4-6.

Textbook on Professionalism

A committee of the Engineers Council for Professional Development is working on a textbook on professionalism designed for freshmen and sophomores in colleges.

According to R. C. Ernst, chairman of the student development committee, engineering freshmen and sophomores in the past have been fed a steady diet of facts—with the emphasis on mathematics and science. He thinks this is the time to give them a start on the road to professional identity.

Tentative outline for the book includes chapters on "What is a Professional Engineer," "History of

the Profession," "Threats to Professionalism, Seniority, and Unionism," [sic] and the "Legal Status of Engineers."

"Professionalism must be taught in college. It needs the same attention as other subject matter. Why has it been neglected? Perhaps because it was lacking in our education when we were being trained," Ernst's report states.

Some time ago, the National Society of Professional Engineers also announced a "Textbook on Professionalism" project, and at last report NSPE was well on its way toward completion of the book.

"Good Response"

The National Society of Professional Engineers survey to discover actual consulting engineering costs on government projects is going well, according to NSPE spokesmen. So far, more than 100 firms have replied to survey questions giving data on approximately 1000 government design jobs. A preliminary report was scheduled for release at the mid-February NSPE meeting in Wichita.

New Institute Officers

Richard H. Tatlow III, president of Abbott, Merkt & Co., has been named president of the American Institute of Consulting Engineers to succeed George S. Richardson, of Pittsburgh.

Elected vice presidents were Gerald T. McCarthy, of Tippetts-

Abbott-McCarthy-Stratton, New York City; and Harold M. Lewis, also of New York City. Named to the Governing Council were John G. Frost, of Wiggs, Walford, Frost & Lindsay, Montreal; Ray E. Lawrence, of Black & Veatch, Kansas City, Missouri, and Gilbert I. Ross, of Ross & Company, New York City.

EJC Annual Meeting

Delegates attending the Engineers Joint Council annual meeting in New York City had an early morning jolt, when at the beginning of the meeting, E. Paul Lange resigned as secretary. The meeting turned into an open discussion of, "What do we do now?"

Since Lange is scheduled to leave on March 4, the board named Leroy K. Wheelock, currently assistant secretary, as acting secretary subject to approval by the executive committee which was scheduled to meet in mid-February.

Who will the new EJC secretary be? Rumors around headquarters are that a former EJC secretary may be renamed to the job.

Lange resigned to become executive secretary of the American Institute of Industrial Engineers, in Columbus, Ohio. AIIE joined EJC as an associate society in 1955 and became a full constituent only last year. Lange has been EJC secretary since 1954.

Unity came up for the usual amount of discussion, with Warren L. McCabe giving a summary of

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happenings to date. He presented a resolution outlining the legal framework of the amalgamated EJC and Engineers Council for Professional Development in order to explain details of the proposal:

"BE IT RESOLVED, that the name of the corporation now known as Engineers Joint Council, Inc. shall be changed to American Engineers' Association Inc. or such other name as may be designated, and that Engineers' Council for Professional Development shall become an operating division of the said corporation. Engineers Joint Council, Engineering Manpower Commission, and Engineers' Council for Professional Development shall constitute the three operating divisions of the corporation, and they shall have the same membership, duties, and responsibilities as they presently have. The corporation shall take title to all the assets and assume all the liabilities of Engineers' Council for Professional Development. Pursuant to this resolution, the Constitution and By-laws of the corporation shall be revised as required in order to effect the above changes."

Right now, no action on the EJC-ECPD amalgamation is expected because both groups are currently awaiting the assignment of a tax classification.

In his luncheon speech, outgoing President Enoch Needles, of Howard, Needles, Tammen & Bergendoff, pointed out that too many engineers think their particular brand of unity would bring professional utopia. What is looked upon as utopia by one man often is considered myopia by another, Needles concluded.

Other subjects discussed were: *Nuclear Congress*—The withdrawal of the American Nuclear Society and the Atomic Industrial Forum was lamented, and it was reported that an inconclusive meeting had been held to see what could be done to pull the Congress back together again. The two withdrew from the Congress last year and

announced they will hold their own nuclear expositions in the future. Another conciliation meeting is scheduled for an indefinite future date. Meanwhile, it was stated that the Congress this month will be the largest in history, with more than 200,000 square feet of exhibition space under contract.

Engineering vs Science—EJC has been disturbed at the Federal concentration on science and research, with a resulting lack of attention to engineering. However, things are looking up. The new Engineers Joint Council president, Augustus Kinzel, has been named chairman of the National Academy of Science Committee on Engineering and Research.

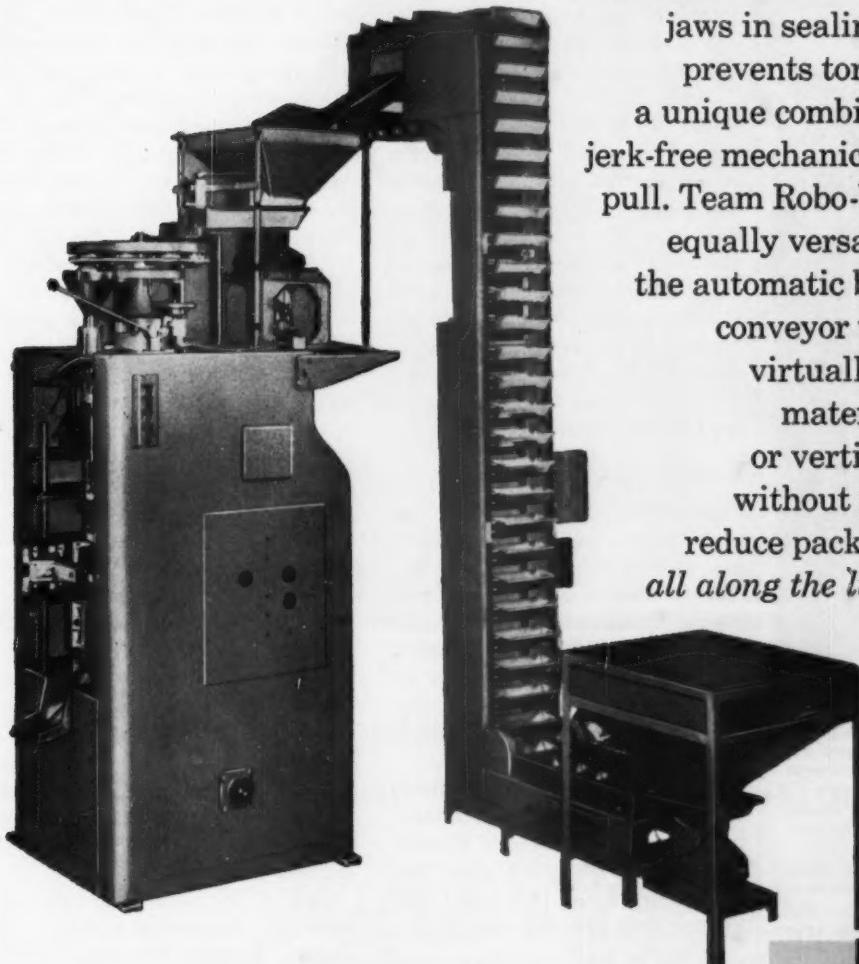
Internationally—Gail Hathaway, chairman of the Committee on International Relations, announced that a December meeting for scientific attaches of all Washington embassies was held in order to disseminate information on EJC, the Engineering Societies Library, and the Engineering Index. Hathaway also announced that application has been made to the National Science Foundation for expense payments for United States delegates to the UPADI (Pan American Federation of Engineering Societies) meeting in Buenos Aires next autumn. The UPADI convention will be preceded by a conference on education.

So far, Canada, Australia, New Zealand, the Philippines, Pakistan, India, Thailand, and Japan have indicated an interest in joining a Pacific and Far East Federation of Engineers. Hathaway said it is hoped an organizational meeting, with EJC representing the United States, can be held this summer, probably in Japan.

Carlton Proctor, who has been EJC representative to UNESCO since it was founded 14 years ago, asked that EJC re-evaluate its interest in the United Nations group. Of the 60 organizations taking part in UNESCO, only 12 (including EJC) are considered permanent

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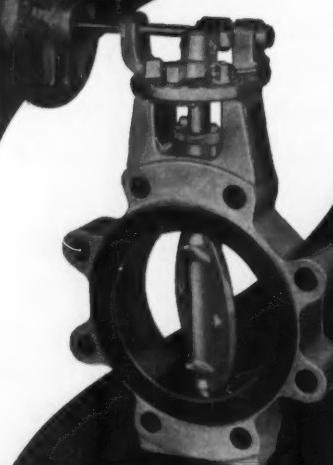
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members. Proctor said that more EJC interest could do much to assure its status as a continuing permanent member.

Employee-Employer Rights—Some time ago, EJC named a task committee to make an attempt at defining the rights of employees and employers. Since the task force is scheduled for dissolution soon, a report or an announcement that no decision can be reached is expected at any time.

New Member—The American Railway Engineering Association is expected to submit a formal application for EJC membership during the next month.

Potential Tax Problems—Since EJC would like to have a tax classification which would allow it to have offices in the new headquarters building, a number of committees have been dissolved. They are Employment Conditions, Labor Legislation Panel, National Engineers Committee, and Committee on the Practice of Engineering. An attorney is deciding what kind of a committee could handle all these functions in the future.

Kentucky CEs Elects Ronald

The newly organized Kentucky Association of Consulting Engineers has elected E. R. Ronald as its first president. The association was formed by 23 consulting engineers from the Louisville and Lexington areas. Membership is open to all consulting engineers in the state who have been in private practice more than five years.

Other officers are: vice president, Trygve Maseng; and secretary-treasurer, J. Clifford Lewis. Elected to the executive board were Stephen Derry, Grant Bell, and Virgil Proctor. It is affiliated with CEC.

In Small Letters

The executive committee of the Minnesota Association of Consulting Engineers has approved a resolution to promote uniform classified listings for consulting engineering firms—terming the use of

all capital letter listings or bold face type "unprofessional sales appeal." The resolution also suggests that "the appropriate committee of MACE be directed to police and to enforce compliance by member firms as well as to solicit compliance by nonmember firms."

Unity Begins at Home

The American Institute of Electrical Engineers, author of the Functional Plan for Unity, is stressing unity on another front these days. At the recent mid-winter meeting, AIEE President Harold Foote explained, "We have been considered an organization for engineers in the power field too long. True, we have had many important committees working in power. And we are keeping up with current developments. But this is only a portion of the profession served by the AIEE. In this day and age, it is almost impossible to have a technical meeting that does not involve some phase of electrical engineering."

In keeping with these sentiments, AIEE is emphasizing cooperation with other groups. As Foote pointed out, during the past year AIEE has taken part in technical meetings with the Institute of Radio Engineers, the American Society of Mechanical Engineers, the American Society for Testing Materials, the Instrument Society of America, and others.

"Let us expand our view of the Institute's potentialities to include the requirements of the very considerable number of young engineers who will join with us year by year . . . until by 1984 they may constitute the working core of our membership.

"And at the same time may we have the courage to adapt or to discard, if needs be, those facilities which have served well but which need to be brought into tune with any determined realignment of our program."

Foote, who is busy seeing that AIEE keeps its interest and appeal to youth, also is worried about the

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young engineers from another standpoint. "Today, probably as a result of the missile fixation, everyone is talking about scientists and overlooking the important role of the engineer. Remember—science produces facts, but it takes engineers to get an end product from the facts."

The AIEE president believes there is sufficient room in the world to emphasize both science and engineering. "Even in our schools science is being overemphasized today. I do not mind this so much until it dominates the program in an engineering school. I think science should be presented as such, without pointing good potential engineers away from engineering."

On the more general question of unity, Foote says the modified functional plan for unity is not dead, it is only waiting. "We have widely distributed explanations of the modified plan. Right now, we think it is good to sit back and let individual engineers throughout the country make their own evaluations of the plan. This year, each AIEE section will have one meeting devoted to a unity discussion. Also, we are waiting for the results of the National Society of Professional Engineers questionnaire on unity to be compiled."

Other business at the mid-winter meeting included the nomination of C. H. Linder, a vice president of General Electric, for the presidency of AIEE.

PSPE Board Action

The Pennsylvania Society of Professional Engineers has announced the resignation as a national director of Edward L. Dryer, formerly of Lancaster. J. D. Carpenter, partner of Gannett, Fleming, Corddry and Carpenter, Inc., of Harrisburg, has been nominated as Dryer's successor. The board also made a change in its rules to provide for the position of an executive director. Clifton T. Kent, who joined the headquarters staff as assistant executive secretary, on December 1,

will be named to the new post at the time of the annual meeting. Duties of the executive director have been handled for the past 10 years by J. T. West, executive secretary and also secretary of the society.

Of Historical Interest

A number of years ago, the American Society of Civil Engineers, the National Society of Professional Engineers, and the American Institute of Architects decided to work out joint forms of agreement for architects and engineers.

ASCE decided to retire from the negotiations, leaving NSPE and AIA to try several more years for an agreement.

Finally NSPE voted at its winter meeting last year to go ahead and published the forms of agreement without AIA approval.

One of the items on the agenda of the last AIA board meeting was possible approval of the forms. No word yet on the decision.

American "Degree Mills"

Mail order college degrees from so-called American institutions of higher learning have become so common in many parts of the world that any degree from an American university is "suspect," according to a recent brochure of the American Council on Education.

Fortunately, phony engineering degrees are scarce. "It is more difficult to fake an engineering background than it is to pretend to have an education in many other fields," an ACE official explained.

A survey of professional organizations, included in the brochure, showed Engineers Council for Professional Development had no complaints on questionable "mail order" degrees in its records.

EJC Newspaper

First issue of the *Engineer*, tabloid published by Engineers Joint Council for distribution to the approximately 300,000 members of EJC constituent, associate, and assistant societies was scheduled for

A.S.M.E. CODE

When you install a B&G Heat Exchanger, you have assured yourself of not only high efficiency, but highest quality construction.

With each B&G Exchanger, a Manufacturer's Data Report for Unfired Pressure Vessels, Form No. U-1, as required by the provision of the A.S.M.E. Code rules, is furnished. This form is signed by a qualified inspector, holding a National Board Commission, certifying that construction conforms to the latest A.S.M.E. Code for unfired pressure vessels. The A.S.M.E. "U" symbol is stamped on each exchanger.

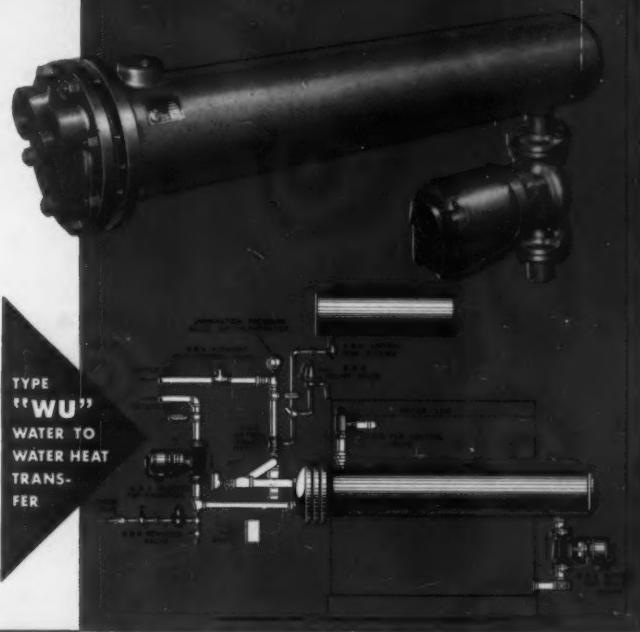
TYPE "WU"

The "WU" Exchanger is equipped with a B&G Booster which pumps boiler water through the shell, greatly increasing the capacity of the unit. An unbelievably small "WU" produces large volumes of hot water. Water temperature is closely controlled...the Booster starts whenever the water goes below the desired degree and continues to run until the water is again at the proper temperature.

When used as a service water heater, a storage tank can be eliminated, because the "WU" heats water as rapidly as it is used.

Heat Exchangers

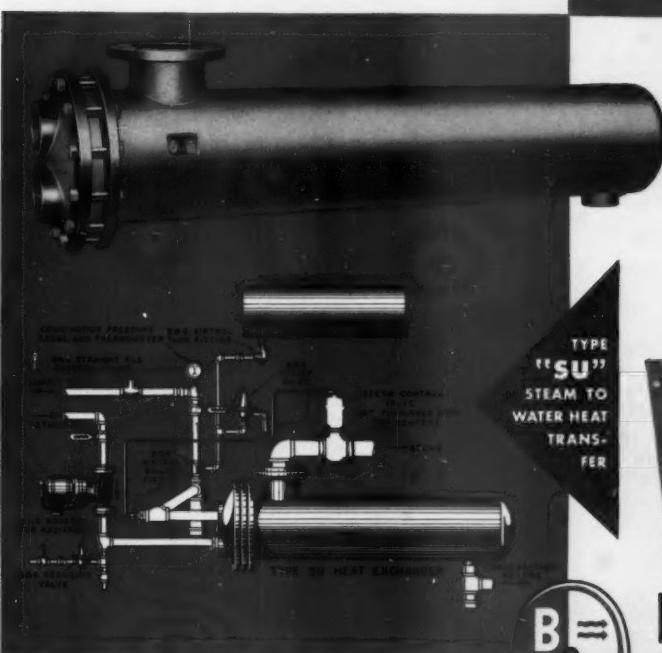
FOR RADIATION AND WATER HEATING



TYPE "SU"

In buildings where steam is required for process use, the advantages of a forced hot water heating system can be obtained by installing an "SU" Exchanger instead of an extra boiler.

This exchanger also provides an efficient, low cost method of heating water for apartments, hotels, hospitals, industrial and processing plants. No storage tank is needed.



For complete information send for "WU" Catalog No. GC-1054 and "SU" Catalogs No. SC-159 and SI-159.

BELL & GOSSETT
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Dept. GC-70, Morton Grove, Illinois

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mailing on Feb. 15. The initial issue stresses government, Nuclear Congress, and engineering manpower stories.

For some time, there was difficulty deciding whether *Engineer* (a quarterly with a \$15,000 budget) should be an insert for member society publications or be a separate newspaper. *Engineer* also had the distinction of having had and lost one editor before the first publication date. The current edi-

tor is Carlton Pearl, who has handled public relations and publicity for EJC in the past.

Cut Clerical Costs

The National Office Management Association, in Willow Grove, Pennsylvania, has devised a clerical job evaluation plan which will help to decrease steadily rising clerical costs. This plan, which has been tested and found workable, tries to match the money going out

with the degree of skill in the various jobs. The aim is to make the paycheck and the value of the employee match.

You can check your secretary for elementary skill, responsibility, and effort put forth. These check sheets are subdivided to give points for education, training time, memory, analytical skills, personal contact ability, dexterity, and accuracy. They do not know where you can get a new secretary if yours fail.

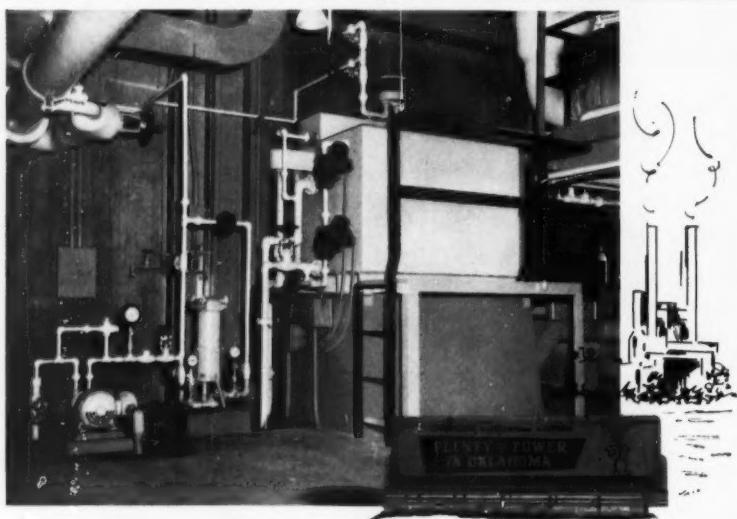
MES and MSPE Joint Action

Executive committees of the Michigan Engineering Society under President Joseph Wilbur and the Michigan Society of Professional Engineers under President N. O. Saulter met in Lansing to consider the report of a joint committee appointed by the two presidents to explore the possibility of joint action by the societies in areas of mutual interest. These areas include education and vocational guidance, legislation, and public relations.

A liaison committee, appointed by the two presidents, will coordinate all activities and recommend appointment of joint committees where this action is required. This committee also will explore the possibility of a joint annual meeting of the societies in 1963.

Chairmen of the legislative committee of each society will be invited to become a member of the other's legislative committee as a means of promoting better cooperation in this important area.

In a joint statement, Presidents Saulter and Wilbur said: "As a general principle, we felt that joint action and close cooperation of the two societies, each maintaining its own organization and identity, can be beneficial in the broadest terms for all engineers and the engineering profession. The areas suggested can be based on joint committee activity and are not dependent upon amalgamation or any other changes at the state organization level."



NUGENT Oiling and Filtering System

Protects 150,000 KW Steam Turbine

The Nugent Oiling and Filtering System shown above serves a 150,000 KW Westinghouse Steam Turbine. The installation is located at the Riverbank Generating Station of Oklahoma Gas and Electric Company, Oklahoma City.

Among the pieces of equipment comprising this Nugent system are:

- Fig. A736-20S turbine oil gravity filter.
- Fig. 687-3 sight overflow.
- Fig. 1020TB-3 motor driven oil circulating pump. (10 GPM, $\frac{3}{4}$ HP)
- Fig. 1555-4S oil polishing filter. (pressure)
- Fig. 1142 two-compartment oil storage tank.

(Not shown.) Capacity dirty oil compartment—5000 gals. Capacity clean oil compartment—750 gals.

Whether you require a single component or an entire oiling and filtering system, see Nugent first. You can prolong the service life of valuable equipment through Nugent's finer products . . . better methods.



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3460 CLEVELAND STREET, SKOKIE, ILLINOIS

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DETROIT ROTOSTOKER C-C (Continuous Cleaning)

In any test you
want to apply
DETROIT
ROTOSTOKER C-C
(Continuous Cleaning)
will stand out

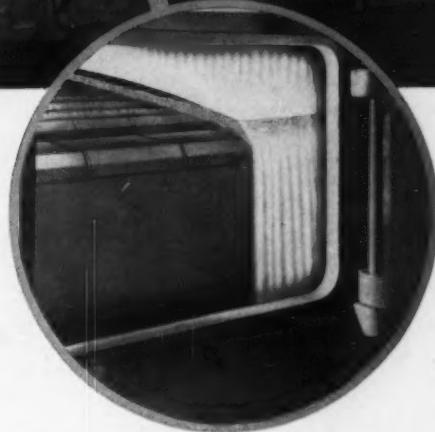
Detroit RotoStoker C-C (Continuous Cleaning) with reciprocating grates that continuously clean the fire and discharge ash at the front, where it may be taken from the ash pit at floor level if desired, avoiding need for a basement ash bunker. High sustained efficiency, high availability low power for operation — For boiler capacities from 5,000 to 75,000 pounds steam per hour.



Efficiency, availability, flexibility under fluctuating load, ability to burn good or low grade coals or waste materials, durability, low parasite power consumption and low maintenance. RotoStoker C-C scores high on all points.

Among those who have tested the RotoStoker C-C — found it a winner — are such well known names as:

Allied Chemical & Dye Corporation
Alpena Power Company
American Cyanamid Company
American Radiator and Standard Sanitary Corp.
The Electric Auto-Lite Company
Automatic Electric Company
Carlisle Tire & Rubber Company
Columbian Carbon Company
Darling and Company
E. I. du Pont de Nemours and Company
General Motors Corporation
General Tire & Rubber Company
Manchester Board and Paper Company, Inc.
National Gypsum Company
Newberry State (Mich.) Hospital
Pittsburgh Steamship Company
U. S. Dept. of Defense
Wake Forest College



RotoStoker C-C is typical of the Dependable Detroit Line which includes stokers for efficient firing of boilers from 3,000 to 400,000 pounds per hour steam capacity.

DETROIT STOKERS COST LESS: COST EQUALS INITIAL INVESTMENT PLUS UPKEEP PLUS PRODUCTION LOSSES DUE TO EQUIPMENT OUTAGE. THE TOTAL IS LESS WITH DETROIT.

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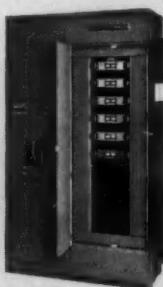
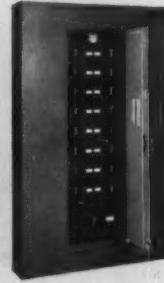
...design leadership



...design 1



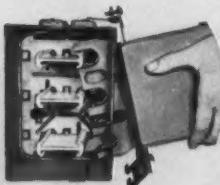
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and Power Panelboards



Power Distribution Switchboards and Switchgear



Plug-In
Duct



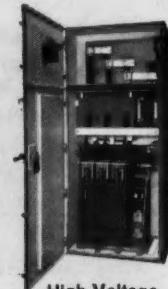
Feed-In
Duct



Motor
Control
Centers



Synchronous Motor
Starters



High Voltage
Starters

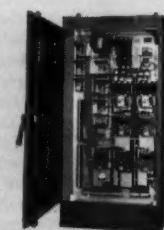


Wireways

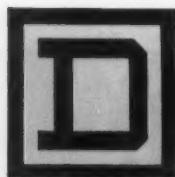
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is available to architects and consulting engineers through more than 100 Square D offices, backed by 1000 authorized electrical distributors and 19 plants in the United States, Canada, Mexico and Great Britain.

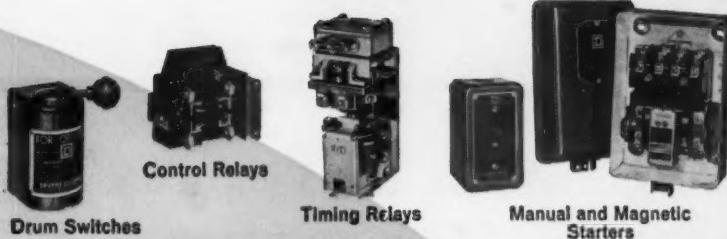
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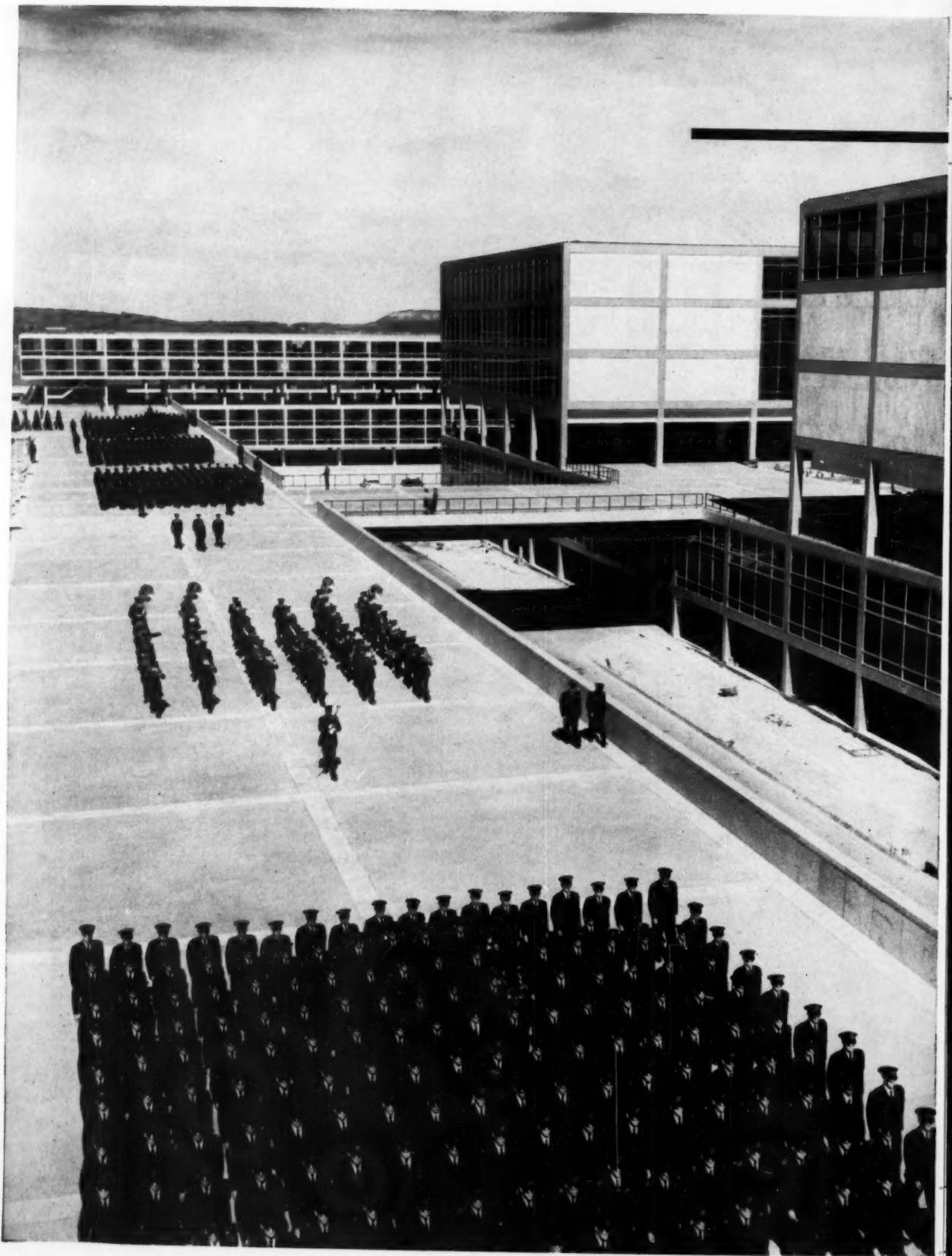
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wherever electricity is distributed and controlled



The new United States Air Force Academy perched at 7,200 feet above sea level near Colorado Springs and Pikes Peak.

AT THE U. S. AIR FORCE ACADEMY
GAS-operated CARRIER ABSORPTION
REFRIGERATION PROVIDES TROUBLE-FREE,
ECONOMICAL COOLING

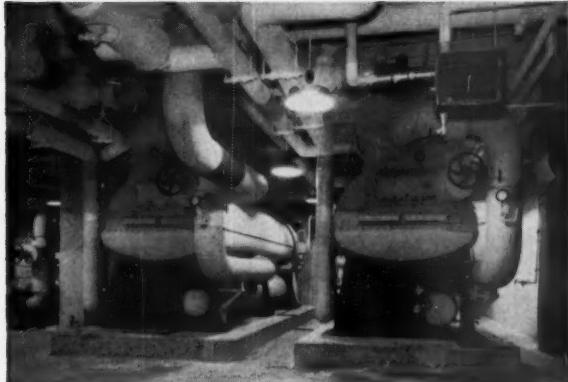
To provide comfort cooling, the new U. S. Air Force Academy is equipped with one of the most efficient, up-to-date, economical types of systems available today — gas-operated Carrier Absorption Refrigeration.

The absorption refrigeration unit makes use of one of the oldest and most reliable principles of refrigeration. No prime mover is required, only low-pressure steam or hot water. Seasonally idle or excess boiler capacity can be put to use on a year 'round basis.

This same type of automatic operation can put your heating system on a year 'round paying basis, too!

With gas as the boiler fuel, operating costs are cut to a minimum. This Carrier machine operates without noise and vibration . . . and because it is so compact and lightweight, it can be put almost anywhere — from basement to roof.

This is only part of the story of the efficiency and economy of specifying gas-operated Carrier Automatic Absorption Refrigeration equipment. Specific performance, engineering data and cost details are yours for the asking. Just call your local gas company, or write to Carrier Corporation, Syracuse 1, New York.
American Gas Association.

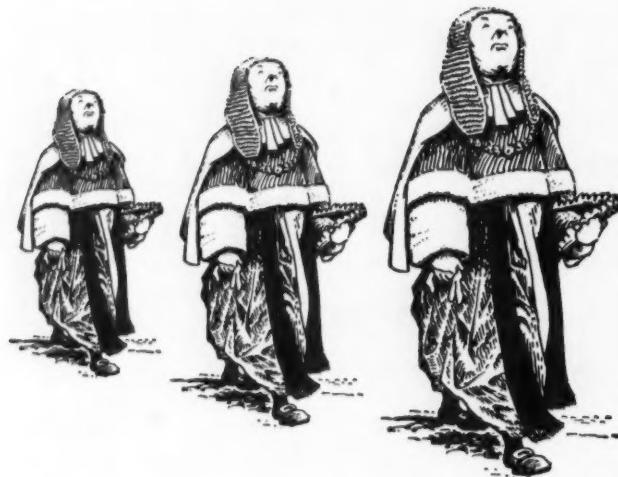


Gas-operated Carrier Automatic Absorption Refrigeration

- cuts operating expense
- lowers installation cost
- provides quiet, vibrationless operation
- answers space and weight problems
- automatically adjusts to varying loads

Architects: Skidmore, Owings & Merrill





The Legal Aspect

MELVIN NORD, P.E.

Consultant in Legal and Technical Problems
Patent Attorney

The Law of Real Property: Tax Liens

ONE sad-but-true fact about real property is that the owner is subject to taxes and may lose his property if he fails to pay them.

Tax Liens

In general, unpaid taxes become a lien on the property taxed, without the requirement of prior proceedings at law. Statutes normally prescribe a certain time when the lien automatically attaches if the tax has not yet been paid. The lien is perpetual, in the sense that it continues until payment of the tax (or until tax sale).

A tax lien is not lost or discharged when the owner sells the land. The purchaser is subject to the tax lien, regardless of whether he knows of its existence or not.

A tax lien is superior to all other liens or claims, including judgment liens and mortgages; even though it attaches after another type of lien or mortgage, the tax lien takes priority. For example, a first mortgagee may find it necessary to pay the taxes in order to keep the land from being sold by the state thereby cutting off his mortgage. If he does so, he can add this amount to the mortgage, and this particular lien he now has will have priority over all other liens and mortgages. However, if a second mortgagee pays the taxes, his lien for the taxes will be prior to the rights of

the first mortgagee, because he has acquired the rights of the state with respect to the tax lien.

Sale for Delinquent Taxes

When real property is subject to a tax lien, no foreclosure proceeding is required in order for the state to recover its money. Generally, the land is subject to tax sale by the state, without the need for any judicial proceedings (such as foreclosure by suit in equity, as in the case of a mortgage). However, some sort of judicial proceeding must be available to the owner if he objects to the sale.

Statutes are provided in each state setting forth the exact procedure (such as notice to the owner) to be followed by the state in this sale. Failure to follow this procedure strictly makes the sale void, providing it prejudices the rights of the owner.

Notice and Hearing

Before property can be sold for delinquent taxes, the owner must be notified. Failure to give him reasonable notice is a violation of the constitutional prohibition against taking property without due process of law. Usually, the notice need not be by personal service on him, or even by letter. It is sufficient if it is by publication in a newspaper—called constructive

notice. However, if the statute requires that notice be mailed to him, this condition must be satisfied in order to make the sale valid.

If the owner objects to the sale, procedures are established by statute providing him a hearing. At this hearing he may present legal objections to the sale.

Usually both the taxpayer and the state are given a right of appeal from a decree as to the sale of tax delinquent lands.

Who May Purchase at a Tax Sale

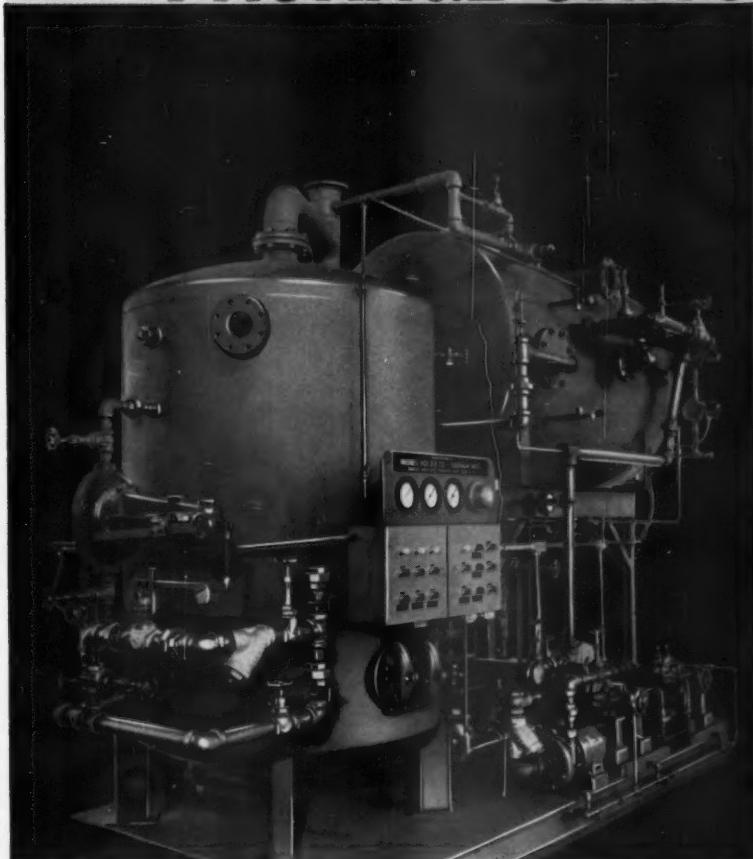
Anyone may purchase at a tax sale, unless he is disqualified by statute from doing so. However, if the person who is under the duty to pay the taxes purchases at the sale, this is regarded as in effect a payment of the taxes and discharge of the tax lien. In other words, he does not cut off the rights of mortgagees, as would occur if anyone else purchased.

Similarly, if anyone is obligated by contract to pay the taxes, he cannot obtain any advantage by defaulting on this obligation and then purchasing at the tax sale.

When there is no purchaser willing to pay enough to discharge the tax lien, the property may be bought by the state itself. It may be sold subsequently by the state to a purchaser, free of all former liens and mortgages, including the

WICKES BOILER AUXILIARY PACKAGE UNITS

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Save On First Cost • Engineering •
Building Space • Construction Time •
Operating and Maintenance Cost

Wickes Boiler Co. now offers a packaged system of various compact combinations of DEAERATING FEED WATER HEATERS, BOILER FEED PUMPS, CONDENSATE SURGE TANKS and BLOW-OFF TANKS. Standard units available for steam plants of 10,000 to 100,000 lbs. of steam per hour capacity and steam pressure to 300 PSIG. Information on special units of higher capacities and pressures upon request. Each unit is shop-assembled on a structural steel base, completely piped and wired and equipped with all necessary controls and an instrument panel.

Write today for Bulletin 59-1, which gives detailed engineering information on all three models of Wickes Boiler Auxiliary Package Units.



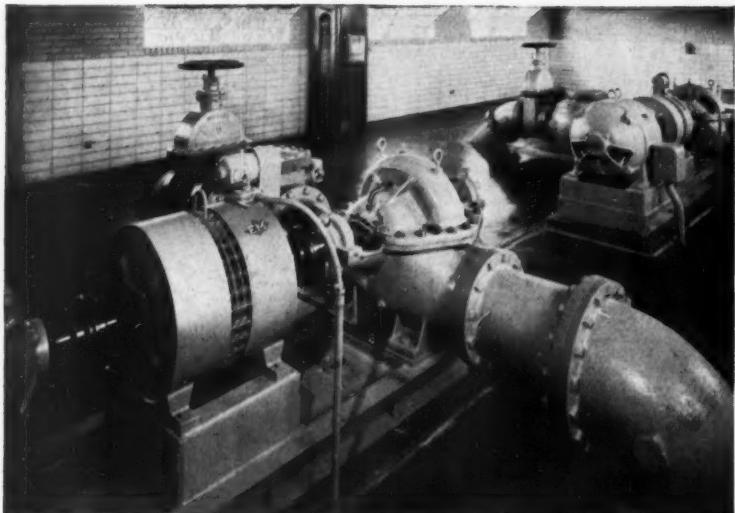
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E-M Ampli-Speed Drives provide Odessa, Texas Municipal Sewage Plant with adjustable pumping rate of 1 to 5.4 MGD. Pumps are held to $\pm 2\%$ of manually selected speeds.

Make two pumps do the work of three!

Here's how Odessa, Texas did just that with
adjustable speed E-M Ampli-Speed Drives

PROBLEM: Odessa, Texas wanted to increase sewage facilities to treat sewage effluent as a source of industrial water for chemical and rubber plants.

OBJECTIVE: They needed a new, efficient sewage pumping station at minimum cost, with provision for future capacity.

SOLUTION: Odessa officials called in Parkhill, Smith & Cooper, consulting engineers of Lubbock, Texas. P. S. & C. suggested two alternatives: 1. Build a plant with three pumps, including one for peaking and standby; or 2. Install two pumps with E-M Ampli-Speed Drives.

Parkhill, Smith & Cooper favored the 2-pump plan for these reasons:

Minimum Capital Investment. The three-pump plan would tie up a considerable amount of capital in an extra pump, motor and control without adding appreciably to the

volume of sewage pumped.

100% Peak Standby Capacity. Two pumps with E-M Ampli-Speeds could handle present demand efficiently, yet still have enough reserve capacity for 100% peak standby.

Low Cost Expansion. Later another pump could be added to double the station capacity and still allow 100% peak standby. And as a further saving, the building would not have to be enlarged to accommodate this third pump.

RESULT: Acting on the advice of its consulting engineers, Odessa accepted the 2-pump plan and now enjoys efficient, low cost pumping.

As your clients' pumping needs grow, give them the economy and versatility of E-M Ampli-Speed Magnetic Drives. Call your nearby E-M Sales Engineer and write for Bulletin No. 243. It contains selection charts and tells how Ampli-Speed works.



**ELECTRIC MACHINERY
MFG. COMPANY**

MINNEAPOLIS 13, MINNESOTA

Specialists in making drives do EXACTLY WHAT YOU WANT THEM TO

tax lien. Such a sale by the state starts a new chain of titles.

Redemption From a Tax Sale

Statutes generally provide for redemption by the owner following a tax sale of his property. This right also is extended to other persons having an interest in the land cut off by the tax sale, such as mortgagees or lienees. The statute fixes a time within which this right of redemption must be exercised, as well as the procedures involved in redemption.

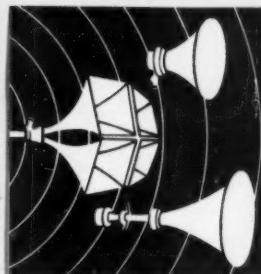
Redemption may be accomplished only by the payment of the full amount prescribed by the statute. This payment will be at least as high as the amount that the purchaser at the tax sale has paid, and it may be substantially higher. This is so even though the person redeeming has an interest to protect which is smaller than this amount.

Tax Titles

A tax title takes precedence over all other titles, and the purchaser takes all the rights of the former owner (subject to redemption rights). Once the redemption rights expire, the purchaser's title is absolute, i.e., not subject to any liens or mortgages (unless some have been added after the tax sale).

The purchaser gets a tax deed, which may be recorded with the register of deeds in the usual way.

If for some reason the tax title is invalid, the purchaser may be entitled to compensation from the original owner for improvements made while the purchaser was in possession of the property. However, if the purchaser had entered into possession improperly, without following the statutory procedure, he may be held to be a trespasser. Then he cannot recover for improvements. In any event, the purchaser will have a tax lien against the original owner, since in effect he has paid the latter's taxes. This lien has priority over all other liens and mortgages. □



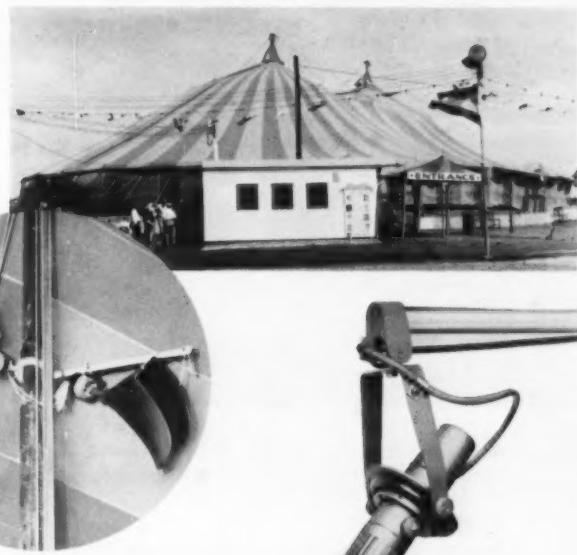
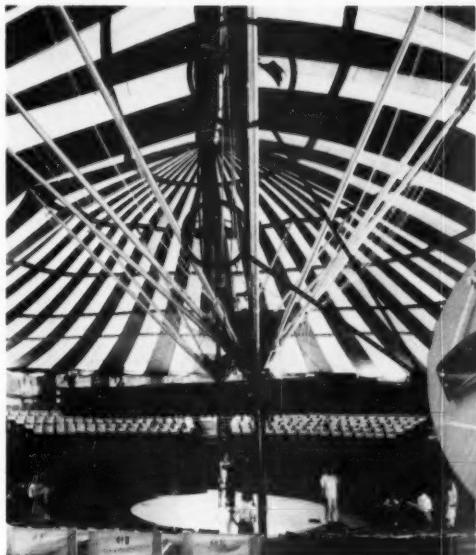
AUDIO NEWS

for consulting engineers



SUMMER THEATRE PATRONS ENJOY "BETTER-THAN-BROADWAY" LISTENING

Sound projection system gives full coverage to all seating locations



A new idea in summer entertainment which has gained quick popularity is the "Theatre in the round"—outdoor theatre staged in large tents such as those used by the circus.

This novel means of bringing "Broadway" to "Main Street" involves the problem of providing adequate sound projection from the stage to the entire seating area. Since actors play to all sides of the stage, several microphones must be used to provide uniform pickup over the entire stage area. The pickup from the microphone must be amplified with true fidelity and projected from speakers in such a way that the sound reaches the entire audience with uniform intensity and creates the natural illusion that the sound is actually coming from the stage.

RCA sound systems meeting all these requirements are used in many popular outdoor theatres. In this type of installation, speakers used for the projection of sound over the seating area are four RCA theatre type MI-9595, 90° radial horns equipped with high frequency throats and speaker mechanisms. Two horns are hung from each of the two main poles of the tent,

about 45 feet above the stage floor and carefully angled downward so that each horn covers a quarter of the seating area. These horns provide an equal intensity of sound throughout.

Four RCA Type BK-5A uni-axial microphones are mounted on the periphery of the stage, at a height of 8 feet. For most effective coverage, the axes of the microphones are declined about 35° from horizontal, and toed in about 15°. Two additional microphones provide pick-up of scenes from side sets in the audience area. Another microphone is used for sound effects, and one for special announcements.

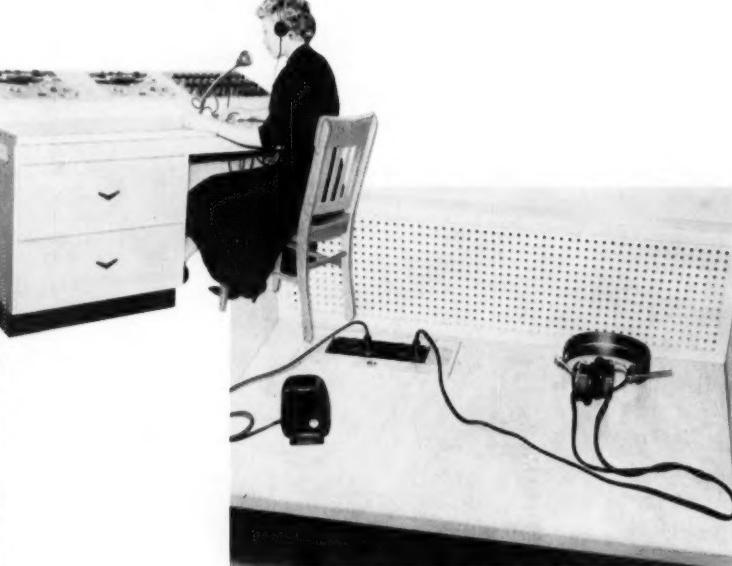
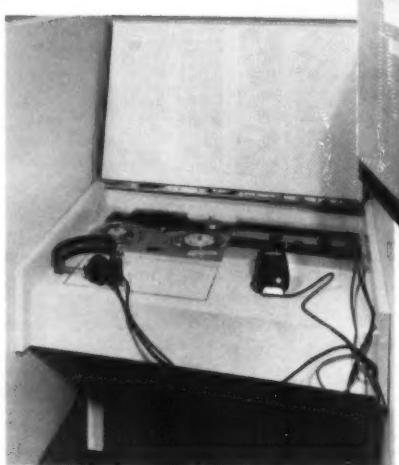
Amplification is provided by two RCA 4-input, 30 watt amplifiers. Voltage stages of the amplifiers are coupled to provide separate mixing for eight microphones.

RCA has a wealth of experience in planning acoustically correct sound systems, and a broad array of equipment to meet the unique requirements of each installation. We would be glad to assist you in planning sound systems for indoor or outdoor theatres or any other type of structure or application.

AUDIO NEWS for consulting engineers

ELECTRONIC LANGUAGE LABORATORIES . . . EDUCATION'S NEWEST TOOL

Tape recorded lessons supplement classroom lecture periods — let student learn spoken as well as written language.



The fastest growing development in education today is the language laboratory — a remarkable teaching technique which has leaped from obscurity to prominence in an amazingly short time.

In a language laboratory, each student occupies a semi-sound proof booth and receives tape recorded lessons through a headset. During pauses in the tape, he uses a microphone to repeat the phrase recorded on the tape. By listening to his own voice over the headphones, the student can compare his pronunciation with that on the recording. Teachers and students both benefit: There's more time for teachers to work individually with students, and students learn to become fluent in a *spoken* language as well as a written one.

RCA sound specialists have teamed with educators to develop an extensive line of Language Laboratory equipment which gives the teacher full control of the class; is extremely simple to operate, and affords a high degree of flexibility.

Versatile RCA "Preceptor" Language Laboratory systems allow a teacher to: (1) Use as many as 10 lesson tape recordings simultaneously; (2) hear both the master tape and student's voice; (3) talk with any student in a two-way conversation; (4) monitor each student selectively; (5) record student responses on central tape recorder; (6) insert comments during this recording. For student recording, single and dual track tape decks and new cartridge tape recorders are available for use in individual booths.

Many variations in systems and equipment arrangements are possible to suit the instructor's preference. RCA "Preceptor" systems can be easily re-arranged or expanded to suit changing needs *without obsoleting existing equipment*.

Transistorized Design

RCA Language Laboratory systems use a compact, transistorized amplifier which consumes little power and offers trouble-free service. A unique design feature permits the entire laboratory system to operate from a central power supply. This results in a safe, low voltage system which requires a minimum of wiring and installation expense and can be expanded quickly and economically.

By applying "systems concept" engineering to Language Laboratories, RCA engineers developed a line of components and controls which provide simplicity of operation, flexibility, and dependable performance at reasonable, school-budget prices.

Complete Information Available

Full details on RCA "Preceptor" Language Laboratory systems are yours for the asking. We will be glad to send you a comprehensive Planbook which includes a brochure, specification data on all components, and other valuable planning information. If you prefer, we will have our nearest RCA Language Laboratory dealer call on you to provide further information or assistance.



RADIO CORPORATION of AMERICA

AUDIO PRODUCTS

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With the new streets—curbs and sparkling, silicon carbide-impregnated sidewalks of modern concrete

**For 43 blocks of downtown streets,
Abilene chose CONCRETE
...the pavement built to stay put for 50 years and more!**

In an all-out fight against "downtown blight", Abilene, Texas, modernized the entire business district with all new concrete streets in one giant renewal project.

Abilene shoppers and shopkeepers alike can expect a whole lifetime of enjoyment from their new, attractive concrete streets. Pavement is six inches of portland cement concrete on a 6-inch soil-cement subbase.

The new streets won't be blocked off for expensive surface build-up treatments every few years or torn up for major repairs. Even on the hottest days concrete doesn't get soft, tacky or slick. Traffic can't push its solid surface into ripples and washboards.

There are no "moving parts" in concrete to cause hidden wear. In fact, concrete grows stronger year by year. That's why engineers predict today's modern concrete pavements will far outlast any other type, serve 50 years and more!

Concrete pleases taxpayers, too. Maintenance costs run so low that the moderate first cost isn't just a down

payment. Even on street lighting money is saved. Concrete reflects light, so fewer fixtures are needed. City electric bills go down.

Cities everywhere with urban renewal problems are going to concrete. It's the first big step in an effective modernization program.

"The 'new look' of our downtown business district is causing plenty of excitement in and around Abilene!"

Says HENRY NABERS, Abilene City Manager

"Our bright new concrete streets and sidewalks are helping to bring shoppers back downtown. Business has really improved since the dedication ceremony."

"The durability of concrete and the low upkeep costs make it the best investment. The good experience with Abilene streets paved with concrete as far back as 1924 helped convince us of that."



PORLAND CEMENT ASSOCIATION

A national organization to improve and extend the uses of concrete

LOCKHEED AIRCRAFT CORPORATION MISSILES AND SPACE DIVISION

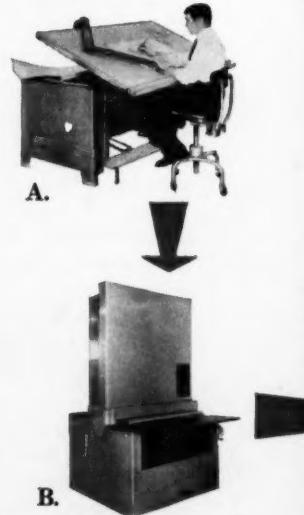


Paragon-Revolute *introduces a great new concept in reduced size reproduction . . .*

RETRIEVABLE MINIATURIZATION



The Paragon-Revolute Continuous Reducing Printer is the heart of Retrievable Miniaturization. Really a giant movie camera, it takes pictures of drawings while they move through the machine at speeds variable from 3 fpm. to 30 fpm. It takes drawings up to 42" wide, offers reductions of 1/2, 1/3, 1/4, 1/5, 1/6, 1/7, 1/8 size. If desired, one of two ratios supplied may be 1:1 for originals up to a maximum of 21" wide by any length. Camera feeds the same as blueprint and whiteprint machines.



Lockheed engineers and Paragon-Revolute representatives compare half-size print with full-size drawing at Lockheed Aircraft Corporation, Missiles and Space Division, Sunnyvale, California. Lockheed officials report that Retrievable Miniaturization has given them the economies and advantages possible from reduced print size without sacrifice of valuable information on engineering drawings.

Andrew T. Johnson, (right) and Robert Johnson, owners of their own reproduction and blueprinting service firm in Boston, were the first to install Retrievable Miniaturization as a commercial service. They state: "Retrievable Miniaturization makes real sense to us—and to an increasing number of our customers. Incidentally, our Revolute Processor is doing a fine job in processing direct positive papers.

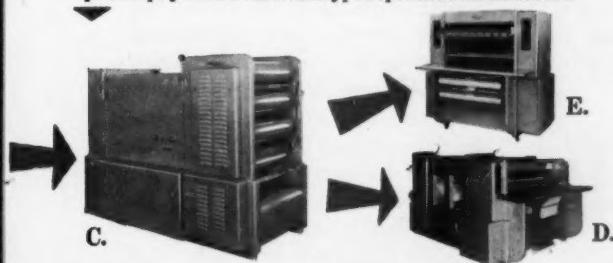


THE IDEA. Retrievable Miniaturization is a new ingenious method for reducing the size of prints yet keeping them large enough to be completely readable and usable. Developed by Paragon-Revolute, this method is acknowledged as one of the significant advancements in reproduction.

HOW IT WORKS. In Paragon-Revolute's unique Continuous Reducing Printer and Processor, reduced-size transparencies are made directly from original drawings for immediate reproduction in blueprint or diazotype equipment. Reductions can be made as positives or negatives on paper or film. The Printer takes drawings up to 42" wide by any length at speeds up to 30 fpm.

THE ADVANTAGES. Retrievable Miniaturization fits in with existing facilities, calls for no drastic changes in present drafting standards

Reduced-size prints are simple and fast to make. A. Original drawings are fed into B. Revolute Continuous Reducing Printer where they are photographed and reduced on paper or film transparencies. C. Revolute Continuous Processor develops, fixes, washes, and dries transparencies for immediate reproduction in D. Blueprint equipment or E. Diazoype reproduction machines.



or print-making systems. It enables savings in materials up to 300% . . . increases capacity of blueprint or diazotype equipment up to 4 times . . . slashes print handling time, filing space, and mailing costs. Most importantly, it provides readable, usable reduced-size prints without the problems and high cost of blow-back systems.

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"Resolution: Engineering services offered to the public shall be guided by the following principles to apply in common, irrespective of whether the engineer is in private practice or is an employee or an agent.

"The engineers are to be qualified in the field in which they are offering to practice. (Any such engineer failing to register in the state in which he is offering to practice before the public should be charged through appropriate legal channels in a court of law for violation of the Engineering Registration Act.)

"The engineer or his firm are to give their clients a full statement of the charges for the engineering work. (Offers of free or cut-rate engineering are to be taken before the Practices Committees of the professional and technical societies for appropriate action against the engineer for violating the Code of Ethics.)

"The engineer shall be completely frank with his client as to his affiliations, if any, with a manufacturer, contractor, or distributor.

"Further, the ethical principles governing a partnership or a corporation are exactly the same as those applicable to the individual. As a firm or corporation is composed of individual engineers, each of whom, whether employer, em-

ployee, or partner, is subject to the principles of ethics, the uniting into a business or professional organization does not relieve them either individually or as a group of the obligation they assume when entering the profession." — Practices Committee, CEAO, as published in *The Oregon Consulting Engineer*, January 1960.

Rail Route for Freeway?

"Utah's road commission may buy up railroad trackage at three or four points along freeway routes to avoid building overpasses.

"Rulon J. Ballard, assistant director of highways, said it would cost over \$1 million to build several freeway overpasses over trackage of the Salt Lake, Garfield and Western Railway, which runs from Salt Lake City to Saltair.

"He said, 'It would be cheaper to purchase the railroad, which is available at less than \$1 million.'

"The trackage would be torn up so the freeways could go directly through. The U. S. Bureau of Public Roads has indicated it would consider participating in buying part of the trackage, if it would eliminate the need for overpasses." — *Deseret News*, Salt Lake City, Utah, January 30, 1960.

Science and Engineering

"Expressions like scientists and engineers and engineering and science jar the sensibilities of those

who insist that engineering is applied science and engineers belong in the rank of scientists. Nomenclature in education is a small help in deciding the question; one of the nation's leading engineering colleges, Case Institute of Technology, was formerly Case School of Applied Science. Now comes an opinion on the subject by a man who is certainly entitled to consideration as an authority. He is William L. Everitt, president of the Engineers' Council for Professional Development, holder of a Ph.D in physics from The Ohio State University. Dr. Everitt, formerly professor of electrical engineering at Ohio State, now dean [of the College of Engineering] at the University of Illinois, insists that science is analysis, determining what follows from a certain interaction of materials and forces; engineering is synthesis, determining the proper combination of forces and materials to accomplish a desired result." — *Science and Applience*, The Ohio State University Research Foundation.

Public Uninformed on Roads

"... Unfortunately, the public has only a sketchy idea of what is meant by the Interstate System, and very little idea of the magnitude and the nature of the benefits to be derived from the construction of modern highways. Until there is a better understanding of

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A-1231



THE BIGGEST MADE IN THE U.S.A., this reversible pump-turbine scroll case has inlet diameter of 18 ft, measures 56 ft across. It's designed for one of Tuscarora's 12 Allis-Chalmers pump-turbines.

Now building 12 reversible pump-turbines for Tuscarora— world's largest pumped-storage project



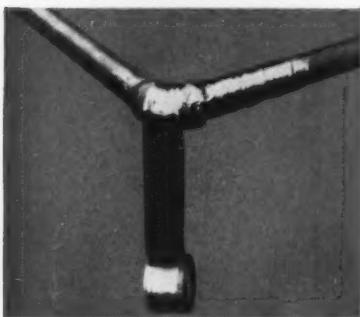
Power plant by day, pumping station at night — the New York State Power Authority's Tuscarora plant will capitalize on the hydroelectric power potential of the Niagara River without adversely affecting the scenic beauty of the Falls.

The largest project of its kind, Tuscarora will have 12 reversible pump-turbines... all designed and fabricated by Allis-Chalmers. As a turbine, each of these units is rated at 28,000 hp under 75-ft head. In reverse, as a pump, each is rated at 3400 cfs against 85-ft head. All will be direct-connected to Allis-Chalmers generator-motors — rating 25,000 kva at .8 P.F. as generators... 37,500 hp at 100% P.F. in reverse as motors.

The selection of Allis-Chalmers to design and build the above components came naturally. A-C is the only builder of complete reversible pump-turbine installations — with a record that includes the world's largest pumped-storage projects.

Look to Allis-Chalmers for leadership in the design, engineering and manufacture of hydraulic turbines and necessary accessories such as valves, pumps, trash rakes, water control gates and hoists. *For information, contact your nearby A-C office... or write Allis-Chalmers, Hydraulic Division, York, Pa.*

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WITH A
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Conduit	Bridge Crossings
Cables	Tie Rods
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Field application costs are lower with TAPECOAT because it is so easy to apply with the use of a torch. No tar kettles, technical know-how or special crews are required. TAPECOAT comes in rolls of 2", 3", 4", 6", 18" and 24" widths—sized to the job.

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highway needs and benefits, it will be next to impossible to have the kind of long-range, consistent, adequate, balanced highway program that is needed for America's growing population and economy.

"About a year ago, the American Road Builders' Association had a survey made in a typical city to determine how much people knew about the Federal-aid highways. This survey, and other independent surveys, have pointed up a great lack of public information about the highway program, and, in consequence, a great lack of public interest in highway legislative problems. Public apathy — public indifference — is not very far from active public opposition, especially in matters involving taxation." — Louis W. Prentiss, executive vice president, *American Road Builders' Association* in an address to members of the Associated Equipment Distributors.

Upgrading County Bridges

"In the current discussion over the degree to which governmental units should use consulting engineers to supplement their own engineering departments, the county government situation with respect to highway bridges should not be overlooked. No more than a handful of the 3068 counties in the U.S. have or can afford to have a staff engineer. But believing, also, that they cannot afford to hire consulting engineers, many counties try to get their bridge engineering 'free' from construction materials companies or contractors.

"Such engineering is never free, and it runs the chance of being inadequate. County bridges produced under this system are probably safe enough, but it is questionable whether they are always the best and most economical . . .

"A case in point occurred last year in Tennessee where counties have followed the practice of hiring a contractor to build a bridge copied from the state highway department's book of standards. That

state's Maury County, however, decided to hire a consultant to design one of its bridges. He prepared, for competitive bidding, three alternate designs, any one of which would have been suitable. The county thus got an adequate bridge suited to a particular site; by awarding the contract to the low bidder, it also got the most economical one.

"The Nashville Section of the American Society of Civil Engineers has used this example in a campaign to get other Tennessee counties to upgrade their bridges by engaging consulting engineers and awarding the construction contract on competitive bids. It is a campaign that deserves to succeed, and be emulated elsewhere." — *Engineering News-Record*, February 4, 1960.

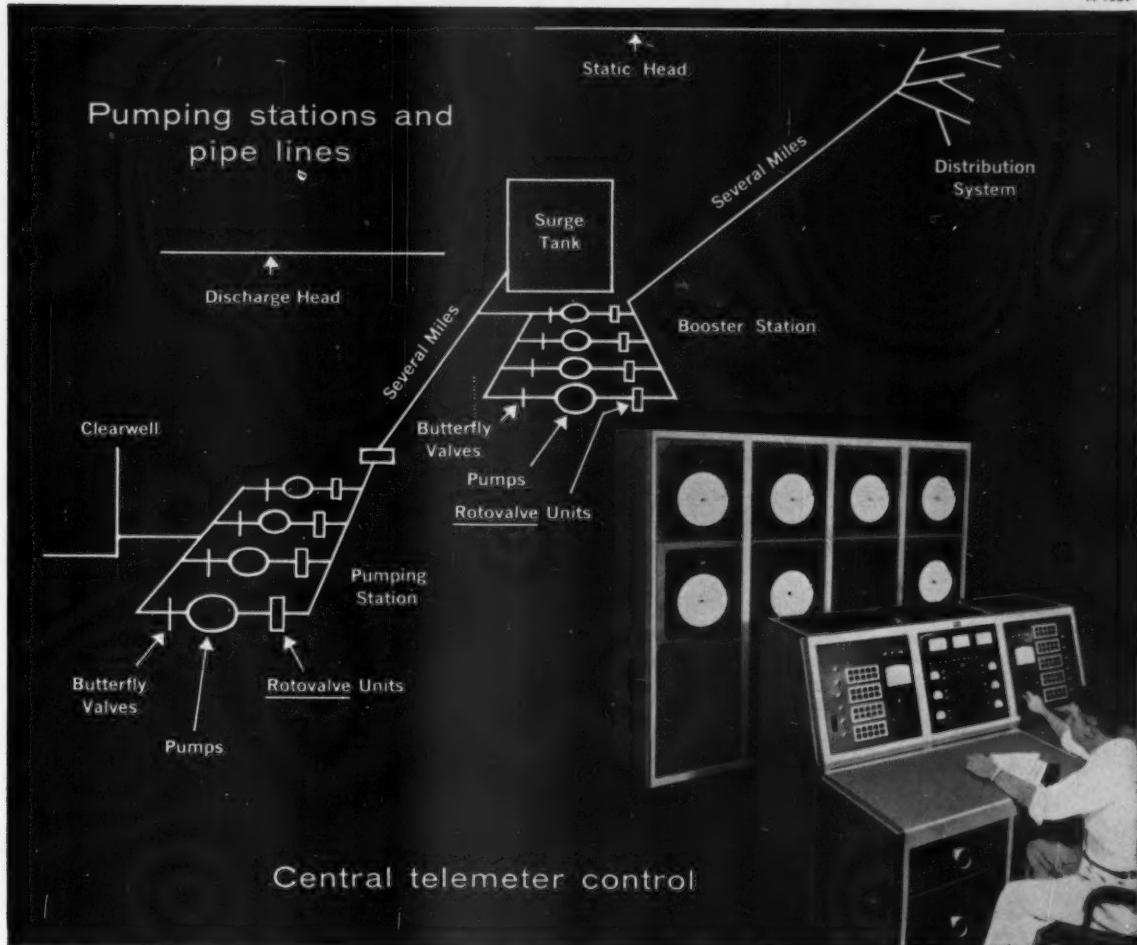
Professionalism

" . . . As is to be expected and as we know, there is work within the broad framework of engineering and on the fringes, that can be done by others quite efficiently. We should not worry ourselves unduly about this situation as some have done because, indeed, all professions have handed down to others historically whatever can be done properly by them so as not to tie up the time of professional men themselves. Truly if employee engineers on the one hand do work which can be done by others, then they stand the chance of being treated just like those others. On the other hand also if consulting engineers insist on retaining unto engineers work that can be done properly by others they will hold back the whole profession. It is ludicrous these days to hear of engineers insisting that other people must not be allowed to do something which they are quite capable of doing when at the same time there is a great shortage of engineers to apply new-found scientific principles. Again we should not worry unduly about turning over the more mundane things, after all we have

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A-1229



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Pumping stations operate completely unattended, controlled from a central remote console in this major water procurement and distribution system. Rated for 60-mgd peak load, it distributes over a 100-square-mile area from widely separated stations and storage tanks.

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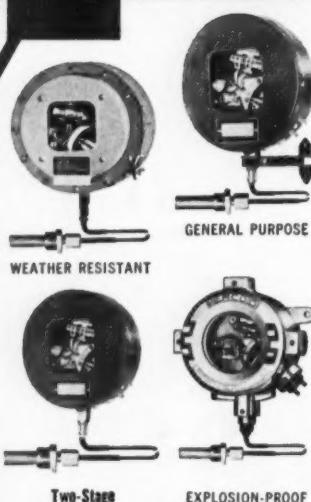
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gases, including highest temperatures and pressures — Allis-Chalmers is your convenient source of today's most comprehensive rotary valve line. Types and sizes cover virtually every need . . . including Rotovalve units, butterfly and wafer valves and ball valves. We can also assist you in every phase of planning, engineering and installation. Contact your Allis-Chalmers representative, or write Allis-Chalmers, Hydraulic Division, York, Pa.



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115V., $2\frac{1}{2}$ A. 230V.) Double adjustment
type for setting both high and low (on-off)
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turned over drafting to draftsmen many years ago and we must now turn over everything that can be done by technicians and others efficiently.

"There is an important difference between a business and a profession. In a business quite often we must insist on obtaining the highest skilled people to do any job at the lowest possible cost. In a profession, in order to protect the public (including economic protection) we insist that the professional work be done by professional people while passing on to others anything we possibly can. This whole topic of whether engineering is a business or a profession is one of the most important keys to the understanding of the status of employee engineers. If engineering is simply business, then we really should not be talking about professional employee engineers. On the other hand, if engineering is legally and truly a profession, we must seriously consider the status of professional employee engineers." — W. J. Riley, *Bulletin* of the Corporation of Professional Engineers of Quebec.

Professional Maturity

"The first evidence of professional maturity is the habit of excellence, which is a reflection of the attitude, the character, and the training of the individual.

"Another evidence of professional maturity is independent, intellectually honest thinking. The mature engineer thinks for himself, he is no imitator, no follower. His conclusions are logical and thoroughly reasoned, and therefore are given the weight and respect of a well considered point of view.

"A third evidence of professional maturity is ability to use the languages of communication with ease and precision. This includes not only the written and spoken words, but also the use of symbols and figures. The talent of expressing thoughts requires the careful erection of the idea in one's own

mind — building it up brick by brick and then tearing it down and re-erecting it brick by brick in the minds of others, using only words and symbols as tools of construction." — Erlind H. Thorsteinson, *The Ohio Engineer*, January 1960.

Failure Research Needed

"... In an era when the failure of a single critical part, in a space rocket, for example, can lead to the failure of a multimillion dollar project, we can no longer afford to rely upon rules of thumb.

"Our technological rivals in other nations can dictate the devotion of large sums of money and many man hours of time to such efforts as machine part failure studies. In this country, however, we must rely on cooperative efforts to accomplish our aims. In the near future, industrial organizations who share this problem will be contacted for help in the execution of this research project.

"The history of machine elements, particularly those which are subjected to contact stresses, has been marked by substantial improvements in accuracy, materials quality control, and design. But because of the lack of understanding of the basic failure mechanism, a major breakthrough has not been made in defining the failure process to permit accurate prediction of the operating life of a given item. Machine elements in this category include rolling elements such as bearings, gears, and cams." — Paul Lewis, ASME.

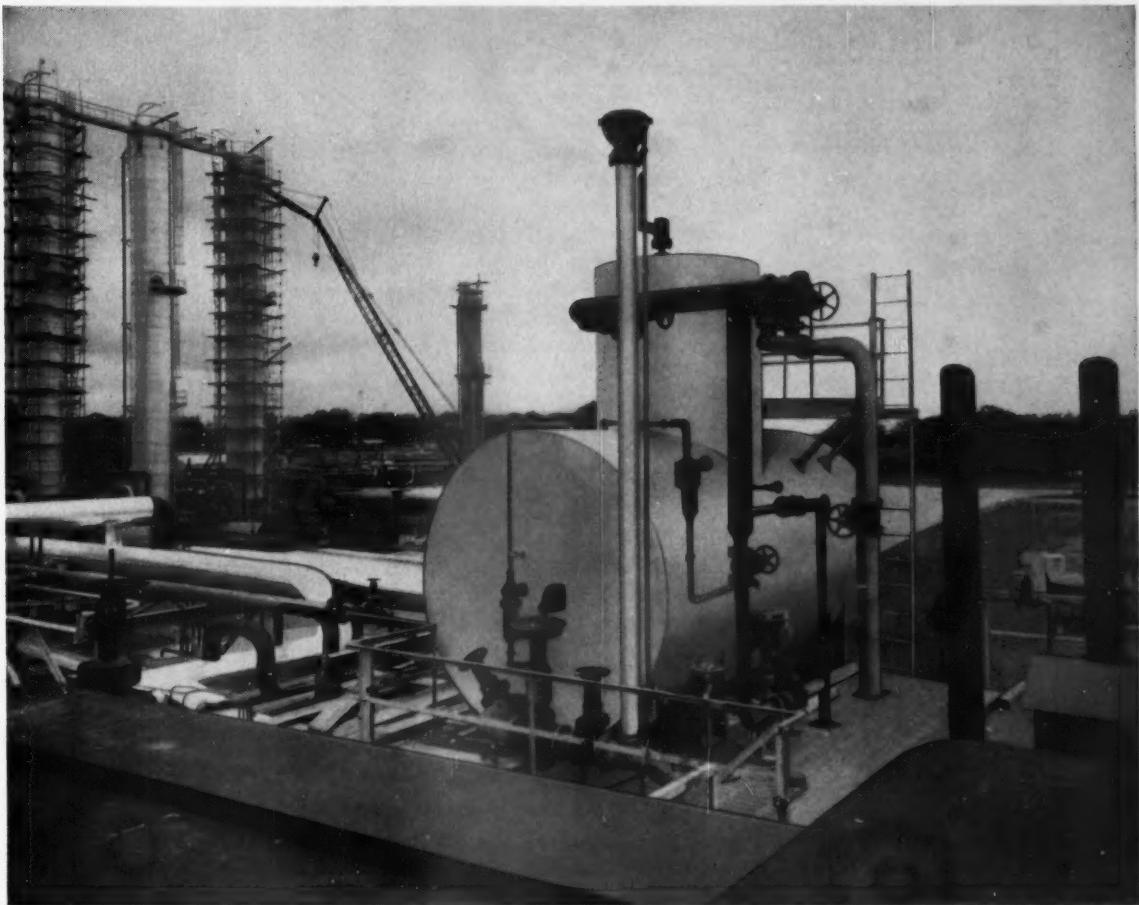
The Architect and His Team

"Let me take a moment to illustrate the importance of team effort, and the opportunity of the architect to act as team leader, by drawing upon our experience in planning the Prudential Center, now under construction here in Boston. The scope and complexity of this \$100 million project are implicit in the fact that it will be the world's largest integrated business, civic, and residential development

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A-1233



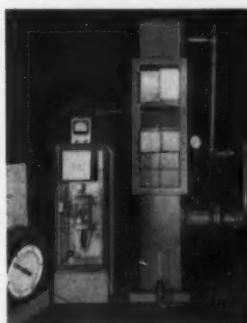
Allis-Chalmers 215,000 lb./hr. tray deaerator with 7200-gallon horizontal storage tank at a southern chemical plant.

Corrosive gases removed

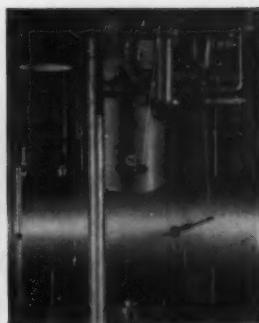
from boiler feedwater with Allis-Chalmers deaerators

Positive corrosive gas removal by Allis-Chalmers tray-type deaerators is proved by a pilot unit (below) equipped with a continuous oxygen analyzer and recorder. It utilizes unique counterflow design for thoroughly scrubbing dissolved gases from the water surface. Design produces maximum heating of water with minimum of steam loss in venting. Effective deaeration is guaranteed under all loads.

Ruggedly constructed, A-C deaerators employ 16-gauge 18-8 stainless steel on all equipment exposed to corrosive gases. No moving parts assures quiet operation, minimum maintenance. Inspection is easy through ample access doors and manholes. Service? Seventy-seven district offices throughout the nation. Your A-C water conditioning engineer can give you full deaerator details. **Allis-Chalmers**, Power Equipment Division, Milwaukee 1, Wisconsin.



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"In designing for the 'human scale' we have been able to achieve a 'freedom of space' atmosphere — what I like to describe as the 'humanization of architecture.'

"We have done this by assigning 75 percent of a 31½-acre area to landscaping, reflecting pools, statuary, terraces, walk-ways, patios, and sculpture gardens. Only the remaining 25 percent is used to accommodate the buildings themselves. The 52-story Prudential Tower is the focal point, surrounded by six 25-story apartments, seven commercial buildings for banks, shops, and restaurants, a 25-story hotel, and the city of Boston's locally planned and developed Municipal Auditorium and Convention Hall.

"In this tremendous complex, the larger buildings for the Center have to be anchored into bedrock approximately 170 feet below ground. Also, the main tracks of the Boston-Albany Railroad and the easement for the proposed 6-lane Massachusetts Turnpike run diagonally across the entire site beneath the Plaza level.

"So you can see at once why the master planning for such a project would have been impossible without consummate engineering skills of virtually every type. The engineers — whether structural, mechanical, electrical, foundation, water, soil, or sound — had to solve such problems as vibration, noise control, traffic, and the trickiness of water tables. Our teammates in these areas contributed immeasurably to the final solution.

"The master planning would have been equally impossible to achieve without the research and analysis of the realty consultants, who found the ways to help us blend aesthetics and economics.

"Similarly, planning for the human scale could not have been accomplished without the collaboration of landscape designers, sculp-

tors, and painters." — Charles Luckman to the 39th Massachusetts Building Congress.

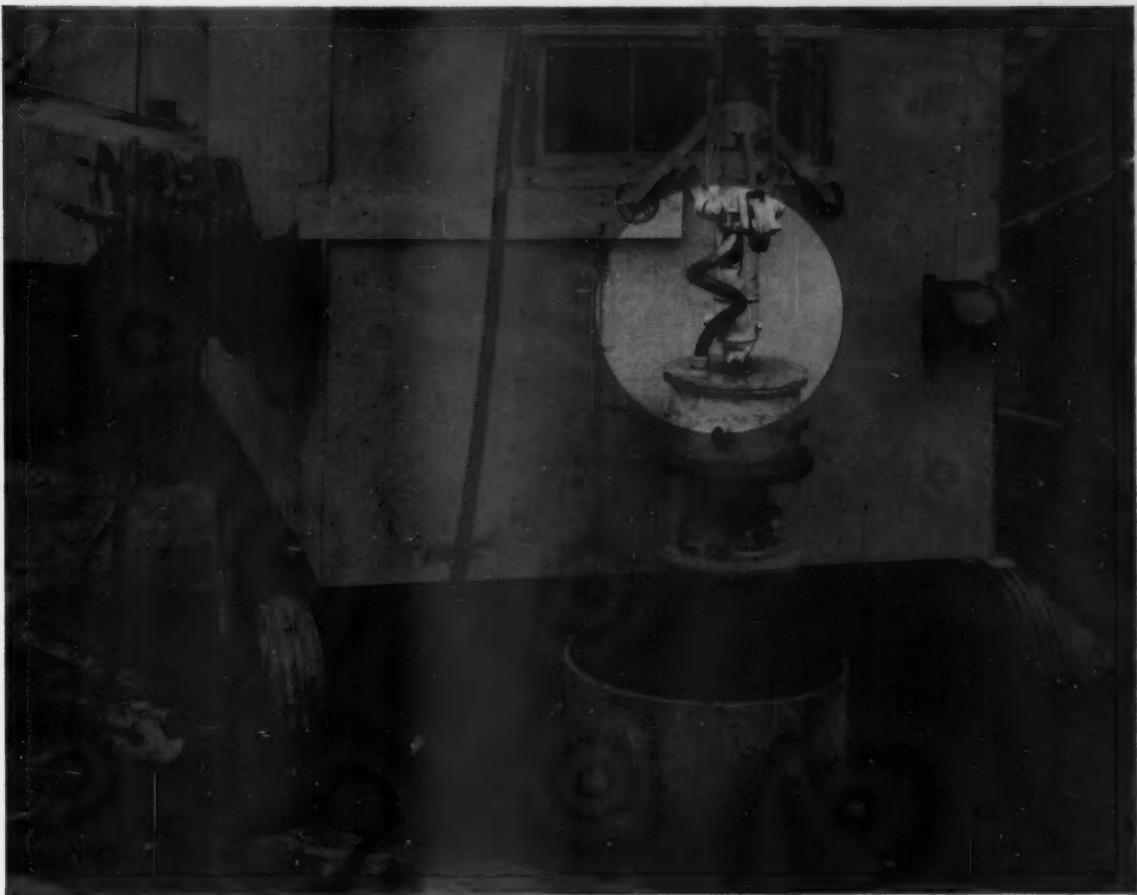
Ugly Americans Needed

"... We cannot grow in the way that we would like to grow unless we participate in the development of the other countries of the world. Only in such participation can we provide an adequate outlet for the manifold energies, skills, and ambitions of our people. The exploration for oil in this country is in a very advanced stage. Anybody who wishes to explore for oil in the future must go out into the world, which is crying to be explored. Similarly, other industries in this country cannot find outlets for what they have to offer except in terms of assisting in the underdeveloped areas.

"The British, I think, reached their heights as a nation in response to an external challenge. Raleigh and Clive and Rhodes would never have found scope within the narrow confines of England. We do not, of course, seek to create a new colonial empire. We must go out to other countries not on the basis of force or superiority, but on the basis of consent. We must seek to work with other people as equals toward the achievement of reciprocal and mutual advantages.

"In so doing I believe that American individuals and corporations, as well as governmental agencies, must all play a role — as Americans, as well as through the United Nations. I do not believe we should try to minimize our 'national' role, or be ashamed of it. By so doing we would rob our contribution of its vitality and our country of its legitimate rewards.

"Do we have a great 'national' contribution to make in world development? Is our participation as a nation not in fact an impelling necessity for our own continued growth and leadership in the world?" — George C. McGhee, in *Saturday Review*, January 16, 1960.



OPTIC NERVE FOR EYES THAT SEE 100 FEET BELOW THE SURFACE

This is a television camera. Its job is to photograph the substrata of excavations, thereby providing information needed by engineers in planning the construction of Boston's new Prudential Center, a modern, multi-million dollar real estate development.

Here in the Back Bay section of Boston, with its artificially maintained water table, this sealed camera must go down into a water-filled hole 100 feet below the surface. To transmit the picture from the camera to the surface monitor, Lake Service Corp. of Brighton, Massachusetts, designers and manufacturers of the television equipment, chose Simplex Anhydrex XX insulated cable because of its ability to withstand the rigors of submarine and direct burial duty.

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Presenting Our Authors

Anton Krapek is a vice president of the Lansing, Michigan firm of E. Roger Hewitt Associates, Inc. Born in Czechoslovakia, he was educated in the United States and is registered as a mechanical engineer in Michigan and Indiana. Krapek is a member of ASHRAE, NSPE, and the Consulting Engineers Association of Michigan. His

mainly with architects, he is well acquainted with the need for a more realistic appraisal of the present fee system which hamstrings engineers on low dollar value proj-



work on the heating systems for various projects in the Midwest stimulated his interest in heating systems for shopping centers. That is the subject of his current article in CONSULTING ENGINEER.

J. L. Breese introduces an interesting solution to the fee problem that arises on most small engineering projects. With his own small firm specializing in mechanical design for buildings and dealing pri-

ects. Breese is a graduate of the University of New Mexico, served as an engineering officer in the USAF, and was a research assistant at Los Alamos before beginning his own consulting practice. He is a member of ASME, ASHRAE, NSPE, and is currently president of the Consulting Engineers Association of New Mexico.

Richard Sanders Allen, who is appearing for the third time in CONSULTING ENGINEER, has put together some fascinating material on early American tunnels. He begins with the early canal tunnels and finishes with the booming era of railroad

tunneling in the East, before the introduction of modern methods and explosives. The son of a consulting engineer, Allen took an



early interest in engineering. The result was a life-long hobby of collecting photographs and detailed information on historic engineering achievements in the U.S.

Bennett Coulson is a graduate of Texas A & M, who managed to squeeze in several years with Texas consulting firms before enlisting in the Navy during World War II. He was assigned to duty on several ships, and ended up his Naval career as commanding officer of a



rocket gun boat which saw service in New Guinea and the Philippines. Before entering the service, he earned an M.S. in Municipal and Sanitary engineering, and attended both Dartmouth College and Purdue University under the auspices of the Navy. He has been in private practice in Houston for the past 14 years, specializing in municipal and sanitary projects. Two of his most recent projects involved over \$14 million in engi-



Architects and Engineers:
Johnson and Johnson, Inc.

02

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3200-FOOT CONVEYER SYSTEM
MOVES 500 TONS OF ROCK PER HOUR**

This vast conveyor system is an example of how Planet Corporation achieved its reputation as a *versatile* organization . . . an organization capable of building all types of materials handling systems and automation equipment from large capacity bulk handling systems to intricate, custom designed production systems.

The 3200-foot conveyor system partially shown above was installed by Planet at a large cement plant. It moves 500 tons of 4½-inch maximum diameter limestone rock per hour on 30-inch wide covered troughed belt conveyors. The longest continuous-belt conveyor (shown in background) is 803 feet long . . . and, except for a few feet at the loader hopper, *it is elevated all the way*.

If you have a materials handling, production, or automation problem, let Planet demonstrate how "PV" . . . *Planet Versatility* . . . will save time and money in finding cost-saving, efficiency-increasing solutions. Write or phone today . . . you'll find *it pays to plan with Planet*.



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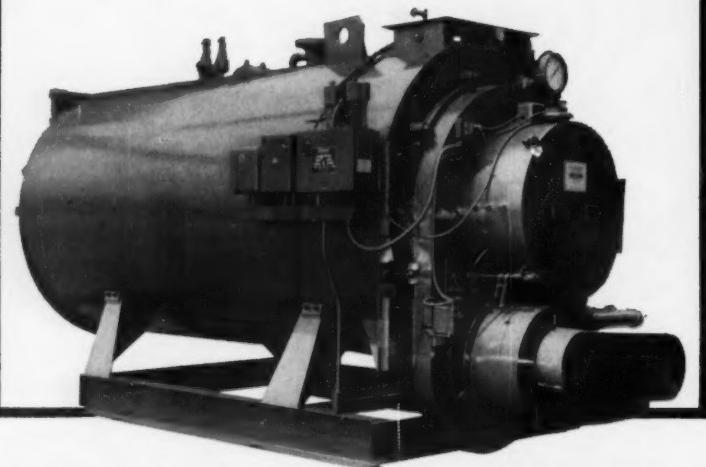
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neering improvements for the Meyerland and Westbury subdivisions of Houston. Knowing the importance of close teamwork in a small engineering office, Coulson recently embarked on a program of psychological testing for both himself and his principles. His article deals with the initiation and results of that program.

Reuben R. Alvy began his engineering career with the USAF, as an engineering officer on design, construction, and maintenance of air base facilities in India. He is currently assistant to the vice president at the Los Angeles firm of Holmes & Narver, Inc. Alvy earned his degree in civil engineering from the City College of New York, and later obtained an M.S. in Structural Engineering from the University of Southern California. He has a broad background in structural design on both military and civilian projects, and was well qualified to handle the position of project en-



gineer on the expansion program for the Los Angeles Sewerage System. The outfalls on this system are the largest, longest, and deepest in the world, and provide some interesting background for his current article on the over-all engineering problems encountered in the design of sewer outfalls. Alvy is a member of Tau Beta Pi, and is licensed as a civil and structural engineer in the State of California. He also holds his own general contractor's license. □

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Engineering Costs In State Highway Departments

STAFF REPORT

ON December 3, 1959, CONSULTING ENGINEER wrote to each of the 50 state highway departments and the District of Columbia, asking for comparative cost figures for engineering work on interstate highways when done by consulting engineers and when done by employee engineers of the state highway departments. In order that a uniform comparison could be made, each letter referred to Technical Bulletin No. 245, *A Reference Guide for Negotiation of Engineering Services for Highway Work*, as prepared by The Committee on Professional Engineering Services of the Engineering Division of the American Road Builders' Association. Enclosed with each letter was a copy of Section V, "Final Design and Preparation of Contract Plans and Documents," which defined the scope of engineering services to be compared, and a copy of the fee curve from the Bulletin. In addition, two graphs without curves were enclosed, one to be used to plot actual engineering fees paid to consultants for express highway work, the other to be used for costs of comparable work when done by highway department employee engineers.

It was fully understood when these letters were written that there was little likelihood of a 100 percent reply with each state highway engineer providing all the data requested. It was felt, however, that these letters would remind the highway departments of the need for comparative figures.

Even more important, the answers, few or many, would show consulting engineers the attitudes of state highway departments and would indicate how these departments made their cost comparisons.

Accounting Systems the Key

In reading the answers received from the highway departments, as published here, consulting engineers will loudly claim that the figures are phony—as indeed they may be in some instances. There can be little doubt that independent auditors, told to include carefully all applicable costs, would come up with figures quite different from those submitted by the state highway officials.

Many consulting engineers claim that the state highway officials are simply being devious—that they know what the truth is but are adept at warping it. It is more likely that most highway departments actually do not have the records required to make true cost comparisons, as many of them state in these letters. Their cost accounting systems were not set up to compare their own costs with the costs of engineers in private practice. Some officials may be glad that these comparisons are impossible, but this is more a matter of fortune than of planning.

There is also no reason to doubt the sincerity of most of these highway people in their claim that their costs are lower than the fees of consulting engineers. They believe this to be true. Usual

government accounting methods generally are accepted without question, and the figures seldom are scrutinized in an effort to make item by item comparisons with private enterprises. Government accounting usually tells the truth, but it fails to tell the whole truth, and it is unlikely that any highway department accountant would be willing to swear that his cost comparison figures for engineering design fulfill all the specifications called for in Bulletin No. 60-2 issued by the Director of the U.S. Bureau of the Budget, which requires that ". . . the costs of both Government operation and private procurement must be fairly computed and complete. The costs assigned to Government operations must cover all direct and indirect outlays, such as pay and other allowances for personal services and leaves; contributions for retirement and disability; supplies; materials; transportation; warehousing; utilities; maintenance; repairs; and similar factors; [and should include] appraisal of elements not usually chargeable to current appropriations, such as depreciation, interest on the Government's investment, the cost of self-insurance (even though it is unfunded)."

Detailed Accounting Not Foreseen

A comparison on this basis is just what consulting engineers want, but, unfortunately, it is not available. It is not possible to provide comparisons based on figures that were never recorded. The highway departments should not be criticized too much in this regard. If some group were to claim that redheads were more efficient in engineering offices than blondes and were to demand figures from consulting engineer firms to prove their statement, consulting engineer firms would have to refuse—not because they dislike redheads or have something to hide, but simply because the bookkeepers did not keep their books in a way to permit such a breakdown. Highway department officials can, with some truth, state that they had not foreseen the need to keep detailed accounts that would permit comparison of private vs. government design costs.

If these highway people can state, quite honestly, that they do not have comparative cost data covering past projects, they cannot claim that they are still ignorant of the need for this data on current and future work. At their January meeting, the ARBA passed a resolution calling attention to the need for uniform accounting procedures in state highway departments so that comparisons can be made. This resolution was passed with many highway people in the audience, with Commissioner Ellis Armstrong, of the Bureau of Public Roads, on the platform, and with copies to be distributed to everyone from the Comptroller General to the

American Association of State Highway Officials. It will be difficult for any highway department to say, in the future, that they did not know there was any need for accurate data that would make possible comparisons of costs.

What Consultants Are Up Against

The following letters from state highway officials show consulting engineers what they are up against. Most consultants will agree that figures of fees paid consulting engineers are just what might be expected. They are, in fact, lower in most instances than the fees recommended by ARBA in Bulletin No. 245. They should be higher in the future if a decent profit is to be permitted engineers in private practice. The disagreement will arise with reference to the figures given for the cost of engineering design when done by highway department employees. To consulting engineers it will seem obvious that these low percentages do not include anything like the total cost of design work. It is claimed that it is possible to take simply straight salary figures plus 100 percent, a conservative estimate of cost, and prove these figures wildly wrong.

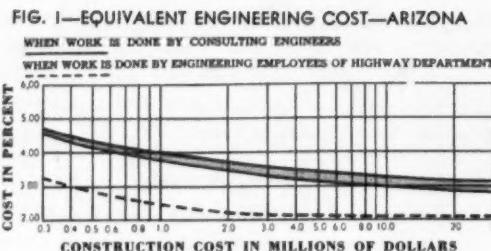
If Congress finds the time during this short session, Washington will be knee-deep in committees investigating the interstate highway program. The question of comparative costs will be of prime importance, and consulting engineers need to know what they are up against.

The opposition is consolidating its forces. At the moment this opposition consists of some well placed civil servants in the General Accounting Office, some of the staff of the Automotive Safety Foundation, and the American Association of State Highway Officials. Over on the consulting engineer's side are the American Road Builders' Association, the Consulting Engineers Council, the American Society of Civil Engineers, the Private Practice Functional Section of NSPE, and a rather nebulous group of heavy contractors who feel that if consultants are replaced by state employees, it will not be long before contractors are, too.

Cost Figures Most Important

In this contest the real ammunition will be cost figures and perhaps a few claims of malpractice. Actual examples of incompetence of consulting engineers on interstate highway work do exist, but they are rare and usually can be traced to political pressure in the selection of insufficiently experienced consulting firms. The cost figures, not the claims of malpractice, are the final determinants of the outcome.

The turn of the battle will depend upon just how successful consulting engineers are in dis-



proving the highway department design cost figures here presented. (On the matter of consulting engineer fees, there is little disagreement.) It is going to be a difficult job. Perhaps the most that can be hoped for is a clear mandate from Congress calling for the adoption of a good and uniform accounting system in connection with Federally financed highway projects. Then, next year and the year after it may be possible to present proof of the savings to be gained by engaging consulting engineers for highway design work.

How the States Replied

State by state, here are the replies received:

Alabama—No reply.

Alaska—No reply.

Arizona—The Arizona State Highway Department uses consulting engineering services when we do more than \$38 million worth of work, this being approximately the capacity of the state highway engineering staff.

The consulting services consist of complete design plans including interchanges, major structures, foundation investigation, and in some cases

material surveys and location surveys at interchange and bridge sites.

The lower curve shown on the overlay sheet (Fig. 1) is for average interstate design without location survey and material survey and report. The upper curve includes the latter items of work. These curves are for average projects and in some cases we may be above or below these curves. The State's cost for like work is only approximate, as included in our costs would be time spent checking work performed by the consulting engineers. The State furnishes complete surveys, material surveys, and traffic engineering for nearly all projects worked by the State and the consultant. This work is not reflected in either of the curves.

*Wm. E. Willey, State Highway Engineer
Arkansas*—We do not have enough samples to properly fill out the graphs since our consultant services have been limited and on a specialty basis. We have had only one contract in which the checking of shop drawings was included.

In general, we negotiate consulting contracts on the basis of the recommended fees of the Arkansas Society of Professional Engineers, a copy of which is enclosed. To this should be added our costs for checking consultant drawings and design. We use approximately 65 percent of the base fee shown, with a slight reduction if the majority of the work is rural roadway. Designs by the State Highway Department are at least 2 percent less.

*Ward Goodman, Chief Engineer
California*—In your letter of December 3, 1959 you requested that we plot curves, on overlays which you furnished, indicating (1) actual engineering fees on an equivalent basis for engineering done

TABLE 1—COLORADO COSTS

Structure Design by Consulting Engineers

Number of Projects: 16

Total construction costs: \$5,094,390

Range in construction cost: \$37,000 to \$717,000

Average percent for fee: 4.65%

Range in fee percentage: 1.88% to 6.83%

(Not included, additional work by state forces, averaging 2.47%, ranging from 4.33% to 0.16%.)

The variable contractual factors being complexity of structure design; the design plus one or all of the following: survey, soundings, checking shop plans, cost estimates, and specifications.

Structure Design by State Forces

Number of projects: 33

Total construction costs: \$2,348,110

Range in construction costs: \$5948 to \$443,875

Average percent of design cost: 2.88%

Range in percentage: 0.97% to 10.10%

Roadway Design by Consulting Engineers

Number of projects: 12

Total construction costs: \$3,701,011

Range in construction costs: \$51,172 to \$876,281

Average percent for fee: 2.19%

Range in percentage: 0.36% to 5.96%

(Not included additional work by state forces, averaging 2.47%, ranging from 3.76% to 0.32%.)

Variable contractual factors: design only; survey only; survey plus one or all of the following: design, soil samples, cost estimate, and specification.

Roadway Design by State Forces

Number of projects: 12

Total construction costs: \$4,923,192

Range in Construction costs: \$43,500 to \$921,083

Average percentage of design cost: 3.73%

Range of percentage: 0.92% to 11.58%

for us by consulting engineers, and (2) our engineering costs on an equivalent basis when done by engineering employees of our department.

We have not made use of consulting engineers for design work of this type in California and so have no information on question number (1).

Our records on engineering costs are not kept in such a way as to make it possible to answer question number (2). The cost of items on which you request information is combined with other costs such as advance planning, handling numerous contacts with many individuals and groups, preparing special reports for the legislature, etc., and cannot be segregated to permit the preparation of a curve such as you requested.

J. C. Womack, State Highway Engineer
Colorado—We do not have sufficient projects on which design has been done by consulting engineers to plot the curves as requested by you. The following information is submitted from available records and may be of use to you. (See Table 1.)

Mark U. Watrous, Chief Engineer
Connecticut—We are most interested in your study of the comparison of costs for design work done by consulting engineers with the cost of equivalent work done by engineering employees of our department. At the present time we are actively engaged in an expanded highway program and will shortly have approximately 60 consulting firms under contract for this type of work. We have had about five years experience with consulting firms on major design work for this department.

Forwarded, herewith, are your transparencies of Engineering Fees and Equivalent Engineering Cost on which the data requested by your letter of December 3, 1959, have been plotted (Fig. 2).

The classification of the type of highway, rural or urban, is not considered in normal highway and bridge design as a basis for different fees. However, when no contracting engineer is engaged for supervision and inspection of construction, the design fee is increased by 0.3% to cover consultation and advice during construction.

Fred J. Thompson, Assistant Chief—Design
Delaware—The attached graph (Fig. 3) represents the actual engineering fees for engineering done

for us by various consulting engineers on nine interstate highway projects, all of the freeway type.

We are not able to comply with your request for similar information concerning the cost of freeway type design by department employees because of lack of information and a minimum of this type design being done by our own forces.

Ernest A. Davidson, Assistant Chief Engineer
District of Columbia—In connection with the design of highway facilities by our own staff, we have maintained a record of the actual engineering cost on a number of projects. However, your letter states you are interested in comparing cost of engineering design work done by consultants with the cost of equivalent work done by our own staff.

We do not have any identical projects which our staff and a consultant designed, therefore, we are unable to furnish you with the type of information requested in your letter.

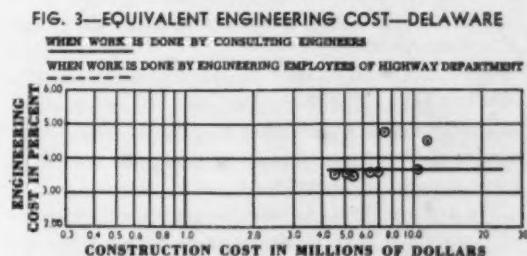
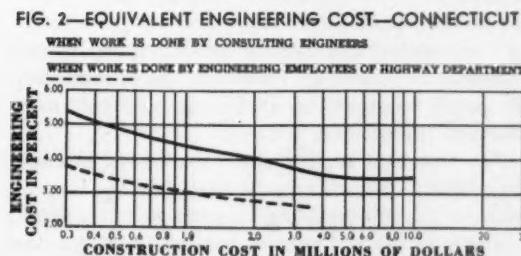
H. L. Aitken, Director
Department of Highways and Traffic, D.C.
Florida—No reply.

Georgia—I do not believe that consulting engineers' fees for what work that has been done in this state would be of a comparative nature to any other state because the work done has been on specialized jobs and are not readily comparable with work in other states.

Future work by consultants in Georgia will be rather limited as we have an engineering force of satisfactory size and capabilities to do our own planning and construction.

M. L. Shadburn, State Highway Engineer
Hawaii—We do not participate in the interstate program and have not employed any consultant for the past two years. Furthermore, we do not maintain cost records in sufficient detail for reliable comparisons to be made of engineering costs on projects designed by consultants as contrasted by those designed by our own forces.

It has been our experience, however, that greater expense is involved in having work done by consultants. Part of this increased cost may be attributed to the necessity for supervising and checking the work of the consultants. We recognize, on the other hand, that our records do not reflect all



the overhead charges which consultants must rightfully charge.

J. C. Myatt, Deputy State Highway Engineer
Idaho—No reply.

Illinois—The complexities of express highway construction in this state are such that in most instances various phases of design work on a particular segment of highway are performed by our own personnel with various other phases being done by one or more private consulting engineering firms. Thus, it is not possible for us to give you a representative graph of comparative fees.

R. R. Bartelsmeyer, Chief Highway Engineer
Indiana—No reply.

Iowa—No reply.

Kansas—No reply.

Kentucky—No reply.

Louisiana—No reply.

Maine—We are in the process of working up information on the subject. I am sorry that we do not have our data in such form as you have requested. It will be quite some time before we will have the information.

Vaughan M. Daggett, Chief Engineer
Maryland—No reply.

Massachusetts—No reply.

Michigan—No reply.

Minnesota—I regret that we are unable to give you data that would provide a satisfactory comparison of the two. On both consultant designed and Department designed projects other factors, such as city and other governmental agencies, in addition to citizen groups, have introduced factors that have substantially delayed design with delay and increased cost to the consultant as well as taking a substantial amount of the Department forces' time on consultant contracts. At least at this time we are not in a position to provide comparative costs.

John H. Swanberg, Chief Engineer
Mississippi—This Department has not, to date, employed a consulting engineering firm for the design of an express highway project. Our employment of consulting engineers has, to date, been limited primarily to toll projects consisting principally of bridge construction and a proposed bridge on the interstate system across the Mississippi River. It does not, therefore, appear that comparative fees and costs as you request are available to us.

Eugene M. Johnson, Chief Engineer
Missouri—No reply.

Montana—Although our experience with consultants has been quite limited to date, it has been sufficient to definitely indicate that we realize better results at lower cost from our own personnel than from the use of consultants.

We are unable to furnish the requested comparisons since we have had no express highway design

work by consultants, but we would appreciate receiving a copy of the compiled results.

Fred Quinnell, Jr., State Highway Engineer
Nebraska—No reply.

Nevada—No reply.

New Hampshire—Your forthcoming article on engineering costs for express highway construction, including a comparison between consulting engineers and state highway department engineers, should be very interesting to both your professional readers and to the general public.

Several excellent consulting firms have done work for the Department in the last few years. The construction cost of these projects has varied considerably. At first glance this would seem to be just the situation for which you are looking. Actually, this is not true. The scope of the engineering work performed, the difficulties inherent in the terrain, the amount of advance planning, the degree of flexibility required to include stage construction, the amount of survey work previously done by the Department, the form in which this information could be made available, the decisions already made, the degree of supervision to be supplied—all of these factors differed widely from job to job. Engineering fees have varied accordingly. While such a situation was entirely justified in the best interests of the State, it completely confuses the picture as far as your projected study is concerned.

Doubtless you will be more successful with other Departments which have employed consultants on a large scale basis as compared to the limited experience of New Hampshire.

R. H. Whitaker, Deputy Commissioner
New Jersey—No reply.

New Mexico—It has not been as easy as I had supposed to obtain the information which you requested concerning the comparative cost of design work done by State Highway Department personnel as opposed to design handled by consulting engineers.

In our accounting set-up, we only charge the direct labor cost to the design work on the job and do not attempt to prorate materials and overhead cost to the separate job. Because of the numerous variations in the jobs designed, it is very difficult to arrive at any definite comparisons. To make a fair comparison would require a long and costly study of all the factors involved.

I am enclosing a copy of data compiled by this department (Table 2) which may be of some help to you. I am very sorry that I cannot supply more detailed information.

On your next trip out this way, I hope you will be able to visit with us. At that time we may be able to go into comparative costs in more detail.

Horry R. Payne, Director, Administrative Services

TABLE 2—NEW MEXICO COSTS

Analysis of Engineering Contracts

SHD	Estimated Cost of Project	Fee	Type of Work
1938	\$ 500,000.00	2.0%	Plans, specs., & estimates for design, including Bituminous surfacing
1938-A	1,000,000.00	2½%	Supp.—Increase in fee due to higher type of design
1961	500,000.00	2.0%	Plans, specs., & estimates for design, including Bituminous surfacing
1802	163,000.00	2½%	Re-design to top of subgrade
1537	420,330.94	\$145.00/day & 115.00/day	Location survey & field notes
2255	3,100,000.00	2½%	Plans, specs., & estimates for design
2149	1,033,817.05	3½%	Plans, specs., & estimates for design (urban project)
3035	500,000.00	3½%	Plans, specs., & estimates for design (urban project)
2815	100,000.00	3½%	Plans, specs., & estimates, through base & prime, major drainage structures, grade separation structures
2836	500,000.00	3½%	Design, including wearing course, major drainage structures, grade separation structures, etc.
2836-A	—	\$7.50/hour	Supp. to check shop drawings
2871	1,800,000.00	2¾%	Design, including wearing course, major drainage structures, grade separation structures, etc.
1891	—	See Below*	Location survey, services, and plans
1891-A	—	\$1000/mile	Survey additional one to two miles
1891-B	—	\$1000/mile	Survey additional 2.74 miles
1891-C	—	2½%	Re-design to new IN standards & 4 lane—net cost for payment purposes to include interchanges designed by State
3051	12,000,000.00	3½%	Complete design, including all structures except bridge across Rio Grande
3231	—	\$900.00	Centerline survey and all pertinent data performed in survey
3364	1,500,000.00	3.55%	Complete design, including drainage structures, grade separation structures, etc.
3265	450,000.00	3.55%	Complete design—all structures, curb & gutter 4-lane (urban)
2872	1,825,000.00	5.0%	Location & design complete—photogrammetric methods
3329	1,125,000.00	3.55%	Complete design—all structures & grade separations, check drawings
3331	1,250,000.00	3.05%	Complete design—all structures & grade separations, check drawings
3280	—	\$800.00/mile	Location survey—47 miles

*N. of Socorro—first 2 miles @ \$800/mile, next 4 miles @ \$1300/mile, and remaining 7 miles @ \$800/mile.

Analysis of Engineering Costs—State Forces

Job. No.	Estimated Cost	% Of Estimated Cost	Type of Work
137	\$1,267,135.66	0.58	Plans, specifications, & estimates —
128	946,083.80	1.98	Plans, specifications, & estimates —
130	982,728.50	2.04	Plans, specifications, & estimates —
173	966,031.22	3.86	Plans, specifications, & estimates — plus location survey
176	1,328,828.05	1.68	Plans, specifications, & estimates —
158	395,167.45	4.14	Plans, specifications, & estimates — plus location survey
269	350,277.50	1.67	Plans, specifications, & estimates —
163	795,335.25	0.86	Plans, specifications, & estimates —
167	333,975.80	3.07	Plans, specifications, & estimates — plus location survey
160	659,349.15	1.10	Plans, specifications, & estimates —

New York—Referring to your inquiry of December 3, 1959, we are familiar with Bulletin No. 245 of the American Road Builders' Association and the curves therein showing suggested "Engineering Fees for Design of Express Highway Projects in the U.S." As the enclosed print of our letter of June 2, 1959 to Mr. George B. Hills, President, Engineering Division, ARBA, and attachments thereto, indicates, we were asked to comment on the report forming the basis for this Bulletin and we indicated

our opinion that the percentages given for design on these curves ran from about $\frac{1}{2}$ to 1 percent higher than our New York State fee. You will note from the May 15, 1959 letter to Executive Secretary Johnson of the American Association of State Highway Officials that we feel it is difficult to precisely compare these schedules in view of the amount of work done by our Department with respect to preliminary route studies, pre-preliminary design prior to the public hearings required by the

Bureau of Public Roads, traffic studies, and analysis and soil investigations.

You have indicated that you are particularly interested in comparing the cost of engineering design work done by consulting engineers with the cost of equivalent work when done by engineering employees of the State Highway Department. Our records indicate that the cost of design by our own engineering employees approximates 2½% as compared with the 3½% paid to consulting engineers in engineering agreements. In this connection, incidentally, we have during the past two years entered into engineering agreements for design work by the New York Office of Borough President of Manhattan at 2½% for design of Harlem River Drive in Manhattan and with the Port of New York Authority at 3% for design of Trans Manhattan Expressway, this latter figure subject to audit of actual Port Authority engineering costs, without profit, by auditors of the Bureau of Public Roads.

**Henry Ten Hagen, Chief Engineer
North Carolina**—The North Carolina State Highway Commission has not used consulting engineers for design work on expressways to an extent that would furnish you with any data in preparing the cost of engineering work by employees of our department versus the cost of engineering work done by consulting engineers.

**C. W. Lee, Chief Engineer
North Dakota**—We are unable to furnish you with a comparison of costs for design work done by consulting engineers with the cost of equivalent work when done by our own employees for the reason that we have not employed consultants for the design of our express highways.

Due to our long winter shut-down of construction, it is necessary to use our construction employees on design during the winter months, thus resulting in our not having any design available for consulting engineers. Also, the fact that North Dakota is largely rural in character precludes the necessity for elaborate designs requiring large design forces.

**R. E. Bradley, Chief Engineer
Ohio**—Enclosed is the overlay (Fig. 4) covering the engineering fees for work done by consulting engi-

TABLE 3—OREGON COSTS

Project	Construction Contract Cost (thousands of dollars)	Engineering Costs (percent)
Urban Highways		
UA	155,000	8.50
UB	1,294	3.74
UC	3,372	2.84
UD	7,843	5.64
UE	8,992	3.02
Rural Highways		
RA	1,192	1.48
RB	2,487	2.15
RC	2,792	2.31
RD	7,860	1.24
RE	10,345	2.62

neers. This graph represents the fees for 11 projects under consultant agreement with this department for the years 1958-59.

The estimates for these projects vary from \$1.8 million to \$12.5 million, and the design fees vary from 3.46% to 3.65%. The services required in these projects are similar and are covered by Section 5—Construction Contract Plans—of the department's Specifications for Consulting Engineer Services.

We are running into some delay in providing figures for comparable projects when the work is done by our own engineering department. When this information is available, we will forward the overlay for these services.

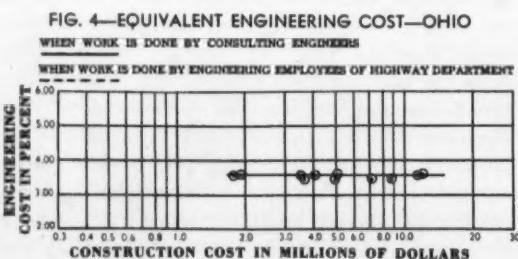
**G. A. Berry, First Assistant Director
Oklahoma**—No reply.

Oregon—We are not able to readily segregate final costs that are covered in Sections IV and V (Supervision) of ARBA Bulletin No. 245, as they are combined in our system. The following tabulation (Table 3) represents a cross section of recent projects in this state; however, the engineering cost percentages cover all those functions mentioned in Sections IV and V.

The costs are for work done by state employees. We have not used independent engineering services for highway design or construction as yet.

**W. C. Williams, State Highway Engineer
Pennsylvania**—Fees paid by this Department to consulting engineers for design of four-lane and wider expressways are slightly lower than those shown on the ARBA curve.

Common usage of buildings, equipment, administration and other overhead for other Department functions, together with the development of construction plans by Department personnel, make it impossible to determine a firm comparative cost



for identical design work, as performed by consultants. Therefore, we are unable to supply the comparative cost figures requested.

Fred S. Poorman, Deputy Secretary—Engineering
Rhode Island—No reply.

South Carolina—I am returning herewith the overlays with lines indicating the cost of each. (Fig. 5) We have not employed any consulting engineers in nearly two years. Prior to that time, we employed consulting engineers on a few of our bridge projects most of which were Federal Aid urban projects.

All preliminary engineering work performed by our Department employees is charged to one cost account; and our records, therefore, do not reflect the percentage of cost for the different types of projects. The cost of 2.6% is the rate approved by the Bureau of Public Roads for the last three consecutive years and is based on the cost of preliminary engineering as compared with the total contract cost for the same period.

S. N. Pearman, State Highway Engineer
South Dakota—No reply.

Tennessee—No reply.

Texas—The work of the Texas Highway Department is handled by our own engineering employees. We have had no need for the use of consulting engineers. I regret that we are unable to be of assistance to you in this matter.

D. C. Greer, State Highway Engineer
Utah—No reply.

Vermont—As of the present time, this Department is not in a position to supply design engineering costs for express highways because we do not have sufficient experience to have developed such records. The design of express highways by this Department is a new undertaking which came in as a result of the interstate. To date, the major portion of interstate highway design has been accomplished through the assistance of contract engineers, although practically all of the preliminary study work done has been accomplished by the Department. Although the Department is now doing its own design work for express highways, we have completed most of the survey work with our own forces and do not feel that any cost information acquired to date would be revealing or representative be-

cause of our going through a transition period and expansion.

With regard to engineering fees for design services performed by consultants on express highways, we have not completed the overlays forwarded with your letter inasmuch as our experience showed that the fees tended to cluster in one area and did not plot the anticipated curve.

To give you the general picture with regard to the cost of engineering work done by contract engineers, our experience has evidenced that the final fees averaged very close to 3% of the estimated cost of construction based on low bid estimates; that is, using the consultant's preliminary estimate of quantities with the actual low bid or construction cost unit prices. This percentage, however, does not reflect the total engineering cost because allowance must also be made for the Department's preliminary studies and for supervisory engineering personnel engaged in the administration and supervision of the contract engineering work.

I regret that we can give you no further information, but sincerely feel that at this time an attempt to do so would serve no purpose and might even be misleading.

H. E. Sargent, Chief Engineer
Virginia—No reply.

Washington—No reply.

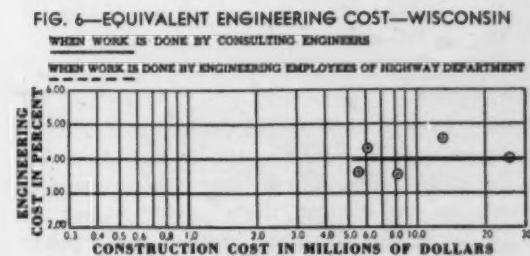
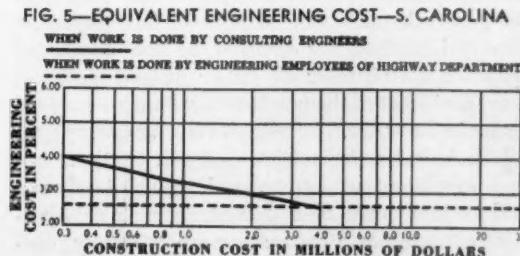
West Virginia—No reply.

Wisconsin—The rather limited engineering work by consultants in the class you have indicated does not provide sufficient points to form a curve trend. However, we have spotted the various points for the contracts we do have (Fig. 6).

With respect to project costs for engineering accomplished by the engineering forces of the state, cost accounting procedures in this state do not provide for comparison. Our costs indicate only such personal costs actually assigned to survey and design. Other costs are controlled by budget and not assigned to individual engineering projects. So we are not able to give you this comparison.

We regret that we are not able to give you a more comprehensive report on your request.

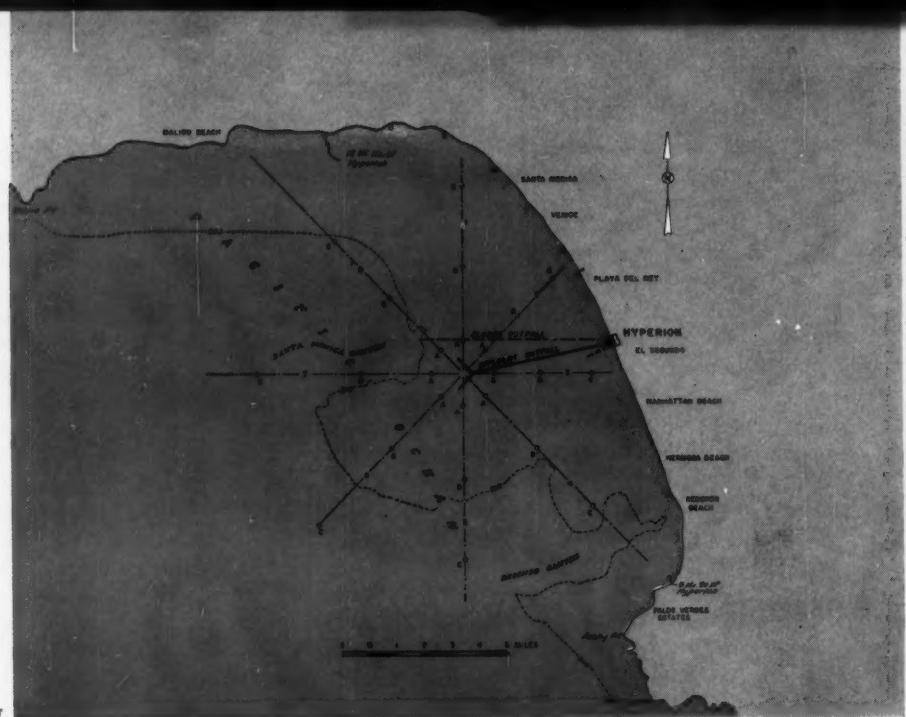
J. S. Piltz, Engineer of Design
Wyoming—No reply. ▲▲



Engineering Ocean Outfalls

R. R. ALVY

Asst. to Vice Pres., Engrg.
Holmes & Narver, Inc.



Small circles indicate monitoring stations for checking dilution of effluent from Hyperion discharge.

OCEAN DISPOSAL of sewage and industrial wastes is practiced in most coastal cities of the U.S. Similar methods also are used by many inland cities located on large bodies of water. The utilization of the diluting capacities of large bodies of water as a direct adjunct to the sewage treatment and disposal problem is, in fact, quite old.

From a water pollution standpoint, the most important factor in ocean disposal of sewage effluent is the amount of physical and bacterial dilution required for various degrees of pretreatment, and the prediction of dilution in the receiving waters. In many instances the effect of the discharge on marine resources and on specific activities in the area may be of paramount importance. Unfortunately, the engineer generally is handicapped in the rational analysis of many aspects of the submarine outfall disposal problem because of a lack of basic information.

Water Pollution Standards

The standards of quality to be maintained in waters receiving sewage wastes are established by public agencies and should evolve from a comprehensive appraisal of particular local receiving water. The design criteria may specify requirements for the effluent, the receiving waters, or both. Underlying these requirements is the prime

necessity of protecting the public health against the uncontrolled spreading of water-borne disease.

Physical and chemical criteria for receiving waters have developed naturally with the growth of experience regarding their effects on marine life and marine activities. For example, dissolved oxygen requirements have been established, as well as standards regarding permissible levels of such materials as cyanides, metallic salts, and even certain radioactive wastes. Requirements with respect to turbidity are in the process of being extended and refined, and from the esthetic standpoint there are obviously upper limits, not only to turbidity, but also to floatable materials and grease. In addition, standards also are established to govern possible accumulation of those solids which settle and tend to form undesirable deposits or sludge banks.

Bacteriological standards for receiving waters are based on premises that are less obvious, less uniformly accepted, and more variable than those for physical and chemical criteria. The generally accepted method for establishing the degree of pollution for virtually all public water supplies is a measurement of the number of coliform organisms living in the water. The coliform is a harmless group which includes *Escherichia Coli* (*E. Coli*), a normal inhabitant of human and animal intestines, and certain types of soil bacteria such as *Aerobacter Aerogenes*. Because they are extremely plen-

tiful in sewage in relation to the number of disease producing pathogens, die off less rapidly than most disease bacteria, and are easy to identify by laboratory procedures, coliforms are used as indicators of fecal contamination. Standards have been established, therefore, for specific numbers of coliforms per unit volume of sea water in excess of which pathogen organisms may exist in sufficient numbers to endanger the public health. However, no completely acceptable standard now exists, and the maximum number of coliforms considered safe in one milliliter of sea water varies considerably from state to state.

Effect on Marine Resources

One of the most difficult problems in ocean outfall design is the evaluation of the effect of the discharge on the marine resources of the receiving waters. Some information is available from existing ocean outfalls, but it is obscured in part by the lack of basic data on the biological conditions existing before the outfall installation. This basic biological information should be obtained during the design phase to permit a study of the possible effects of the effluent in advance. These then can be compared with actual conditions after the plant is in operation. While it is doubtful that any sizable discharge can be made to a receiving water without any effect on the biological character of the area, it is the engineer's responsibility to insure that the gross effect be minimized.

Viability of Coliforms in Sea Water

It is apparent, since pollution is measured by the number of coliform bacteria found in the water, that the survival in sea water of such sewage-borne organisms is of considerable importance in assessing the efficacy of ocean disposal of unchlorinated sewage by dilution. The rate at which coliforms disappear prior to reaching the beach, or other important areas, is a vital consideration in most primary treatment plants utilizing an ocean outfall.

In the design of the new facilities for the Hyperion Treatment Plant of the City of Los Angeles, it became obvious that information available was entirely inadequate for predicting the anticipated decline of coliforms in sea water. This plant was expanded to discharge up to 600 mgd of unchlorinated primary effluent through a new ocean outfall into Santa Monica Bay, an area lined with miles of excellent beaches. The importance of the outfall design was such that little reliance could be placed on the possibility of simulating the mechanisms responsible for the disappearance of sewage bacteria by bottled sea water in the laboratory. It was concluded that only by extensive observation in the field, on outfalls presently discharging coliforms to



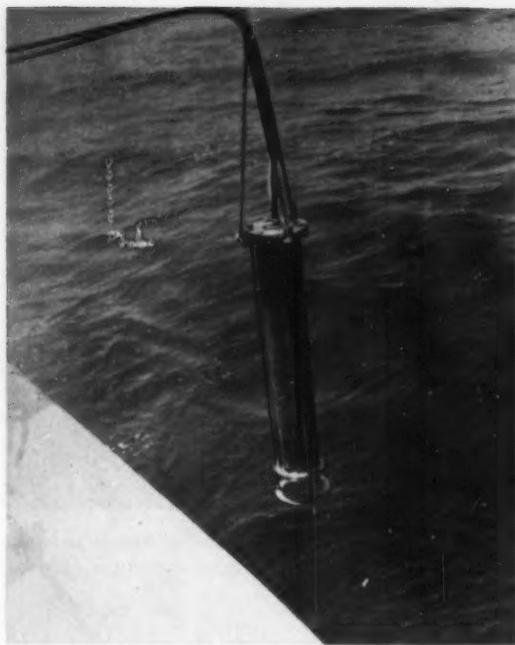
Radioactive tracer used in dilution studies is carefully removed from its lead-lined shipping container.



Tracer is placed in mixing drum within sand-walled shield atop primary tanks before being released.



The initial sewage field containing the radioactive tracer is clearly marked by the introduction of dye.



Scintillator probe was used to check radioactivity of ocean waters at monitoring stations in area.

the sea, would sufficient useful information be obtained for the development of an effective outfall.

Extensive dye patch work was undertaken at three existing outfalls to follow the sewage field, and in one experiment a radioactive tracer was used. Samples were taken at the surface and at various depths throughout water columns, including sediment samples. Profiles were obtained utilizing various parameters for the dilution of a particular slug of sewage as it traversed through the water. In this way the dilutions measured by chemical means could be used to calculate coliform count purely on the basis of dilution. The difference between this figure and the actual coliform count then could be used to calculate the actual rate at which the coliforms disappear in the sea water.

From these studies, it was concluded that, for the time period of concern to the design engineer, the disappearance of coliform bacteria is caused by a number of factors, of which actual die-off is one of the least important. The studies have shown that there is a substantial reduction in the numbers of coliforms in the surface waters and that the principal causes are sedimentation and dilution. It was noted that for the first few hours the rate of disappearance is quite rapid and then decreases sharply. It was further found that the rate of disappearance varied depending upon the type of effluent discharged. Therefore, experiments or the use of ex-

isting data for a new outfall should be based on effluent resembling as closely as possible that of the planned discharge.

Oceanography and Geology

Two factors determine the suitability of a submarine outfall site. The first is the ability of the receiving waters to dilute and render inoffensive the waste discharge in compliance with the standards established for the particular uses of the area. This involves an evaluation of the possible adverse effects of wind, wave, and current upon the sewage-sea water mixture in relation to bathing beaches, natural resources, shellfish growing areas, and recreational areas. The second suitability factor covers those items that must be considered in the design and construction of the outfall, such as topography, nature of sediments, storms, wave forces, currents, and beach erosion.

An intelligent evaluation of site suitability requires a prediction of its oceanographic characteristics plus a knowledge of its submarine geology. A theoretical approach is not now possible, and a series of oceanographic observations at or near potential sites is a necessary part of rational design. Some of the desired information can only be obtained from many measurements taken over an extended period of time. Unfortunately, because of the usual limitations of time and money, an accurate evaluation of such forces is not usually possible, except for major installations.

Undoubtedly the most important single factor affecting the public health aspects of a suitable site is the current pattern. It is essential to establish both surface and subsurface current movements to determine the most unfavorable aspects of sewage discharge into an area. The most important single factor in determining the possible pollution at a particular point is the time it takes the sewage field to reach it after leaving the point of discharge.

Subsurface currents are important for two reasons. Under certain considerations, a thermocline exists in the receiving waters where the difference in density between the surface and subsurface waters is of sufficient magnitude that the sewage field actually remains submerged. This generally occurs in the summer months and was observed during investigations of the operation of Los Angeles' Whites Point Outfall. Still another consideration is structural, since subsurface currents may move or undermine a pipeline that has been laid directly upon the ocean floor.

In order to comply with the standards established by jurisdictional agencies, it is sometimes necessary to determine the effect the sewage discharge will have on the physical and chemical characteristics of the receiving waters. It becomes essential, there-

fore, to establish the conditions existing prior to the discharge. A survey should be made to determine such characteristics as turbidity, salinity, dissolved oxygen, types of marine life, plankton, and nutrients. A later survey will then clearly show changes.

Although wave action can be significant in transportation of sewage fields, its effect on structural design and construction techniques is even more important. A study of the waves caused by such phenomena as tides, storms, and swell must be made to determine the forces to be resisted if the pipe is exposed. If these forces are of sufficient severity, burial of the outfall may be required. In addition, wave data should be made available to the contractor to aid him in planning construction.

The type of foundation material, topography, and erosion characteristics are of prime importance in the design and construction of an ocean outfall. These three factors may well determine the type of materials to be used, the design of the joints, and the construction techniques. During the oceanographic investigations, fathometer runs can be made and the topography of the general area established. Samples can be taken of the sediments and probes made to determine the depth of the soft sedimentary layer, if one exists. Data can be collected for analysis of the changes in the profile of the beaches and the near shore region, which may result in the undermining of the outfall if not properly planned.

Location of Discharge

The most difficult problem confronting the engineer in the design of an ocean outfall is the location of the discharge. Although present day requirements include standards covering physical, esthetic, and chemical features of the resulting sewage field, the

designer soon will realize his most baffling problem is the maintenance of low coliform counts along the shoreline. Of course, if the plant effluent has been chlorinated or otherwise treated to kill all or most of the bacteria, this is no longer a problem.

For economic reasons, mixing and dispersion must be accomplished as near the shore as possible. If structural and construction considerations are temporarily neglected, the desired point of discharge becomes a function of the current pattern, nature and quantity of effluent, initial dilution or size of sewage field directly over the end of the outfall, distance to shoreline, coliform disappearance rate, depth of discharge, and other miscellaneous factors. Actually, several of the items just mentioned are interdependent, and the over-all problem can be divided into two phases. The first, initial dilution, is concerned with the mixing and dilution of the sewage mass in the immediate proximity of the discharge point. The second, spread of sewage fields, is associated with the ultimate disposition of the sewage-sea water mass, particularly insofar as the coliform counts that occur along the shoreline are concerned.

In modern outfall design, it generally is desirable to obtain as much initial dilution or mixing as possible. Wide dispersion of the effluent within the receiving waters not only greatly reduces unsightliness, but also reduces local oxygen depletion and buildup of sludge deposits. It is apparent, therefore, that the multiple outlet diffuser section is preferable to a single, open-end port.

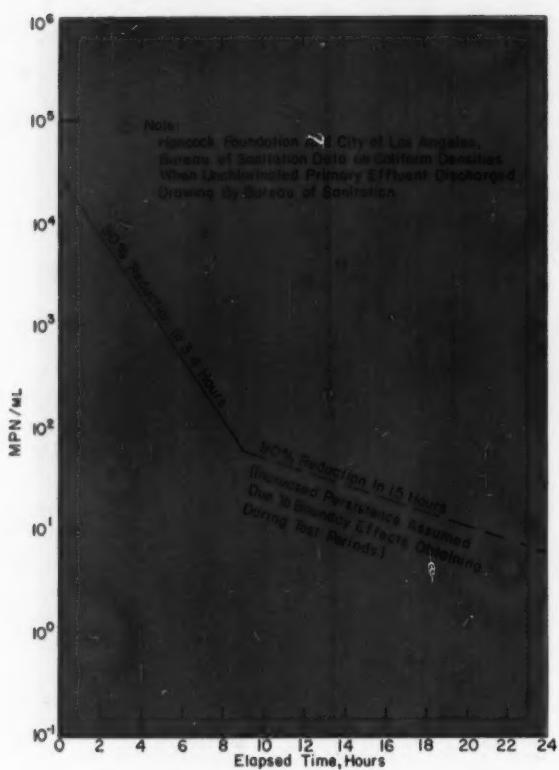
The extent of dilution of the effluent with the sea water obtained upon initial subaqueous injection is related to the design and operating features of the outlet or diffuser and to external conditions



Monitoring equipment for radioactive tracer study is located on oceanographic survey vessel, *Velero IV*.

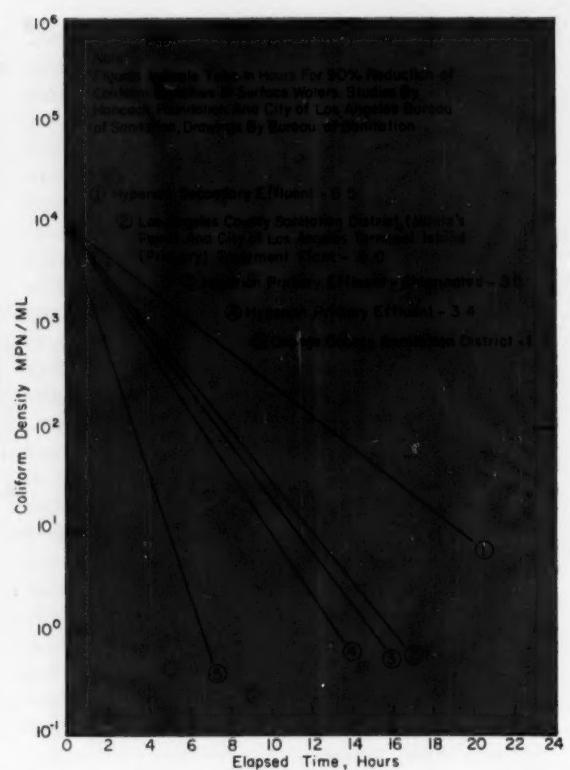


Coliform dilution tubes are set up aboard *Velero IV* from ocean water samples taken in course of survey.



Average reduction of coliform densities in Santa Monica Bay surface waters following the discharge of primary effluent from the Hyperion Sewage Plant.

in the receiving waters. The fluid mechanics of a single jet outlet discharging into a body of water of different density is complex. However, a great deal of empirical and theoretical work has been done on this subject.

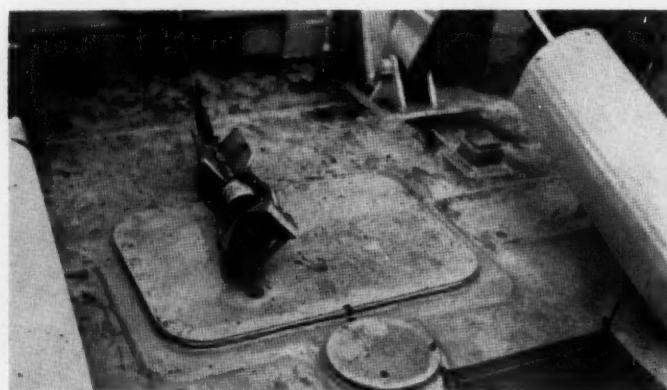


Comparison of the average reductions of coliform densities in ocean surface waters resulting from the discharge of several different types of effluent.

Of great importance is the necessity to establish what degree of initial dilution the outfall must achieve. It is obvious this value is a function of the distance of the discharge from shore; the closer or shorter we make the outfall, the greater must be the



Coring tube was used to get bottom samples, with 100 pound weights added, as needed, for penetration.



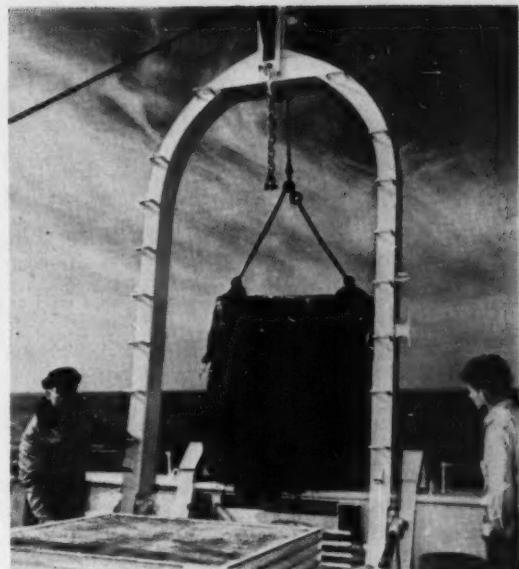
Bottom samples were obtained with a number of different devices, including small "snapper" sampler.

initial dilution. As greater degrees of dilution are required, the methods of achieving it become more elaborate and complex. The designer may be forced into studies involving single and multiple outlet discharges as well as diffusers. If very high initial dilutions are required, and if the quantity of flow is of great magnitude, tee and wye type diffusers will have to be considered. The length of the legs will vary depending on the degree of dilution desired. An example of a large diffuser is that designed for the new Hyperion Outfall where a wye type was used, with each leg being 4000-ft long and containing ports at 48-ft o.c. Ultimately, the correct solution involves an economic analysis of the various cost factors so that a proper balance can be established between outfall and diffuser length.

Probably the two most important considerations involved in the spread and dissipation of a sewage field are the matter of physical dilution and, even more important, the rate of bacterial removal. The degree at which these processes have progressed when the field has reached a particular location is based on the time of travel (dependent on current patterns) and the rate of coliform disappearance (designated as T_{90}). There are apparently many complex interrelationships involved in this process, many of which are not entirely understood as yet.

During the design of the new Hyperion Outfall, Hyperion Engineers undertook an extensive study of the approaches taken in the past. Various equations were applied to the data of many existing outfalls and the results analyzed. It was found that no one equation was suitable for all conditions, but that each had certain specific advantages in its proper area of application.

Using one of the above approaches, it may be possible to determine the dilution of a spreading



Rock dredge, suspended from A-frame, was also used in ocean bottom exploration along outfall routes.

sewage field at a particular installation. However, extreme care should be taken in the method employed to insure the proper degree of conservatism. Use of two or more approaches, with final adoption of one that is a modification of those presented, may be necessary. Understanding the limitations of these methods, the designer will be able to predict the length of outfall required for a specific size sewage field with a pre-established initial dilution. By balancing various degrees of initial dilution, which are contingent on different types of diffusers, against



Hayward grab sampler is orange peel bucket type used for collecting large, unwashed bottom samples.



Aqua-lung divers used jet probes to explore bottom. The divers used were either engineers or geologists.

outfall size and length, an economic evaluation can be made and the most advantageous point of discharge for the effluent located.

Structural Design and Construction

Any major outfall will require a great deal of investigation. The structural requirements for the design of the pipe not only must include bedding and anchorage requirements, but must be closely coordinated with the best possible methods of construction. In addition, corrosion of the pipe in an ocean environment becomes extremely important because most outfalls are designed for long life. Because of the nature of the material passing through the pipeline, the outfall should be designed to permit cleaning to prevent an excessive buildup of friction head due to solids accumulation.

Outfalls can be either a rigid line with welded or other rigid joints providing the continuity of a continuous unbroken pipe, or a line made up of short, fabricated units with flexible joints relatively close together. Of the two, the structural requirements are more rigorous for the rigid line. Therefore, for a proper economic evaluation, sufficient data must be obtained to permit the design of either system, provided the ocean bottom conditions indicate that both are feasible.

For design purposes, it is necessary to determine the contours of the ocean bottom in the general area where the outfall is to be located. In some areas existing USC & GS survey maps may suffice, but in others a hydrographic survey may be required. By plotting various profiles, sudden changes in slope

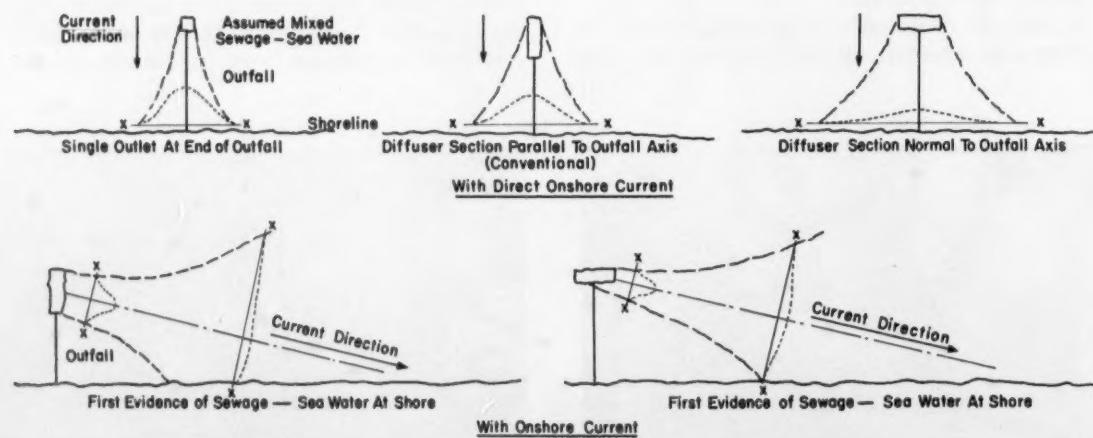
can be determined. Unusually hard or rocky areas as well as very soft sections also should be located.

In addition to the bottom sediments, other important considerations include scour and bottom movement. Scour may be serious in areas containing strong subsurface currents. The effect of waves and surf also must be considered. If conditions are bad, the pipe may have to be buried or provided with special protection. The seismic history of the region also should be studied, since bottom movement can be caused by earthquakes.

Adequate support of a rigid pipeline resting upon or passing through the sediments of a marine environment cannot be taken for granted, unless a special bed has been prepared. The conditions of sediment strength and degree of consolidation are considerably different from those encountered in ordinary soils.

The stresses induced in a rigid pipe of very long length are very difficult to compute. Consideration must be given to conditions which force the pipe to span considerable distances. Still another complicating item is the force necessary to pull the pipe during construction. This force can be of sufficient magnitude to restrict the amount of sag in the pipe, thereby resulting in increased distance between points of support.

The sag of a pipe section having a span of great length introduces difficulties in computing the induced stresses. The pipe may be considered a beam which is so long that when vertical deformation occurs it is accompanied by a significant elongation. The firm supporting sediments will tend to restrain



Schematic performance diagram of two types of outfall diffusers shown in contrast with single outlet at end of outfall. Effect of horizontal diffusion and diffuser orientation on dilution at shoreline are clearly shown. Ordinate of dashed curve from X-X axis represents magnitude of contaminant ($1/S_o$) with respect to

position on X-X axis. Information taken from a report on an investigation of the efficiency of submarine disposal of sewage and sludge which was given to the California State Water Pollution Control Board in December, 1955, by A. E. Pearson. Conditions shown are, of course, idealized to illustrate typical results.

the movement of the pipe at the ends of the sagging portion so that practically all of the elongation will occur between support points. This can induce a net axial tension of considerable magnitude which must be added to the flexural stresses induced by the bending alone. In a very long span, the bending effect can become so small that the sagging pipe can be considered as a flexible cable. If the span is very short the pipe can be designed as a continuous beam with stresses resulting only from bending plus tension required for pulling during construction. Pipe sag in sediments generally involves both bending stresses and net tension, with the load being carried partially by shear and partially by axial tension. In calculating the necessary moments and tensions, consideration must be given to the actual elastic and plastic properties of the supporting material.

Laying Short Pipe Lengths

Short lengths of pipe have been used for the construction of most sewage ocean outfalls. This requires the handling of individual or assembled units of prefabricated pipe from a derrick barge or tower. The pipe may be laid one unit at a time, or several units may be assembled above water and laid with a rigid strongback. The method of support required for the pipe depends on the type of joint used. If soil conditions permit, and a flexible joint is used, the pipe may be laid directly into a trench or on the ocean bottom. If flexible joints are not possible, pile bents may be required to insure proper grade.

The major difficulty with this method of construction is the making of the underwater joints, especially if the depth of water becomes a factor in limiting the use of divers. In depths over 100 feet, these joints would be very expensive, although recent developments in underwater television techniques may help appreciably in reducing the amount of diver time required.

Pipe diameters of any size can be laid using this method. In general, lengths up to 48 feet are assembled and laid. However, for the construction of the new effluent outfall for the Hyperion Treatment Plant, the contractor elected to assemble 192 feet of 12-ft diameter concrete pipe and lay this entire assembly as one unit. By so doing he eliminated many diver operations, particularly in the deep water of this long line, and saved many months of construction time.

Laying Long Pipe Lengths

The laying of long lengths of pipe has been used very successfully on steel marine lines for many years. There are three methods in general use at the present time, with the choice dependent upon such factors as the length of line, maximum depth,

size of line, type of bottom, currents, and the topography along the adjacent shoreline.

The first method, and the oldest, consists of pulling the pipe along the ocean bottom by towing it out from a prepared ramp or track on the shore with a tug or other vessel and a heavy tow cable. The pipe is designed to provide the right amount of negative buoyancy so that it can be towed reasonably, or pontoons can be used. A sled is placed under the head of the first section of pipe which supports the weight of the pipe as it slides along the sea bottom. The pipe is made up of strings, and as each string is pulled out, the operation is stopped, the next string is field jointed, any necessary coatings applied, and the pulling operations repeated. This procedure was used in pulling 7 miles of Winch pipe for the new Hyperion sludge line in 7 days.

The second method has been used successfully in laying submarine lines over long distances in relatively shallow depths. Pipe sections are delivered to a long, specially constructed barge, where they are bound together and laid onto the ocean floor. The pipe must be supported in a manner to prevent excessive sag. If the operation is interrupted, the pipe end is marked with a buoy and dropped to the bottom until operations can be resumed. The effort required to support the pipe to minimize sag and the possibility of bad weather and swell are the main factors which limit the use of this particular method.

In the third method, strings of pipe are pulled out from a track, floated into position, and then sunk into place. Joints present the major problem in this type of installation. Either the pipe strings must all be joined together while floating and then sunk, or else expensive underwater connections must be made. In addition, there is a great deal of hazard in having very long sections of pipeline floating in the water at one time, particularly in areas frequented by pleasure and working craft.

In the past, most ocean outfalls have used either cast iron or concrete pipe, and occasionally wrought iron. By contrast, the gas and oil industry has used steel pipe exclusively for offshore installations. The actual selection of pipe depends on the specific requirements of the individual outfall. It must be stressed, however, that any material analysis also must include an evaluation of corrosion resistance.

Cast Iron Pipe Joints Flexible

Cast iron has been one of the most popular of all pipe materials. However, the bell and spigot type joint requires accurate line and grade, necessitating the driving of piled bents in most cases. The ball and socket joint, on the other hand, permits a great deal of rotation (up to 15°) without leakage, thus

permitting direct placement on the ocean bottom. Flexibility of the joints takes care of settlement and minor undercutting, and will readily allow the pipe to follow variations in profile. Cast iron pipe is used in short length construction and is more expensive than most other types of pipe. Although it is undoubtedly more corrosion resistant than unprotected steel pipe, there is evidence indicating its longevity is not comparable to concrete or well protected steel pipe.

Wrought Iron Claims Corrosion Resistance

Wrought iron pipe has been selected for several West Coast ocean outfalls. Joints may be welded, or dresser or victaulic couplings can be used. It lends itself to construction by either the short or long length methods and is quite expensive. Claims have been made that its corrosion resistance properties are superior to cast iron, particularly in salt water environments.

Asbestos Bonded Corrugated Pipe

Asbestos bonded corrugated pipes have been used for many land sewerage installations for the past 25 years, and have apparently given excellent service. A relatively recent development in the manufacturing process makes possible a smooth interior, thereby providing the same friction characteristics as other smooth pipe. The nature of its joints is such that it is not suitable for high pressure service. However, for relatively low head gravity lines it may be found economical. The pipe itself is not high in cost but the joints require a rather firm bed and good grade. It is suitable mainly for short length construction.

Great Potential for Plastic Pipe

During recent years, new developments in the field of plastics has made possible the manufacture of plastic pipe in size up to 36 inches in diameter, with excellent corrosion resistance. The pipe falls between concrete and cast iron in initial cost. Its lightness will facilitate handling and can well reduce installation costs. Several types of joints can be developed to permit the use of either short or long length construction. Its lightness, however, would be a detriment once installed, because it would require the use of anchors at frequent intervals to hold the pipe in place.

Known data indicate that this type of pipe is ideal for ocean outfalls in the small diameter range. Its strength is equivalent to steel which, with its relatively low modulus of elasticity, results in the properties required for a strong flexible pipe. Its resistance to attack by many corrosive liquids, including sea water, is immeasurable, and is indicative of potential outfall application.

Unfortunately, the history of direct continuous exposure in an ocean environment has been limited to about 10 years. Although no effect on the properties or characteristics of the material has been noted, consideration must be given to the risks involved in extrapolating such limited actual experience records to important installations. It is felt, however, that this type of pipe has great promise.

Reinforced Concrete Pipe

Practically every subaqueous outfall, which has exceeded 84 inches in diameter has been built of reinforced concrete pipe. In smaller diameters, however, concrete pipe has not been used as extensively. The special care required to make underwater joints generally has led to the use of cast iron or wrought iron, even though concrete pipe is far less expensive initially. Concrete pipe always must be given serious consideration due to its excellent corrosion resistance.

The main difficulty experienced with reinforced concrete pipe has been with the joints. Tongue and groove joints, generally used on land, have proved unacceptable for subaqueous work. In order to overcome the difficulties encountered on some of the earlier outfalls, many new joint details have been developed. Proper joint design can provide a pipe that can be laid directly on the ocean bottom. Concrete pipe has been laid only by short length construction.

Coated Steel Pipe

Steel pipe has been installed almost exclusively in the oil and gas industry for subaqueous work. This type of pipe allows a great degree of flexibility in construction techniques, particularly in designs utilizing long length construction. The obvious disadvantage of steel is its limited resistance to corrosion, particularly in sea water environments. There are several well-tried methods of protection, however. These include protective coatings such as somastic, coal tar, plastic tape, gunite, and asphalt. In addition, for very important installations, it also has been found that a cathodic protection system should be used, usually in combination with a protective coating. Because of the requirement to protect steel against corrosion, the initial cost of steel pipe is generally more expensive than concrete pipe, even in areas of relatively high head. Its main economy lies in its adaptability to rapid fabrication and installation.

A list of references on the subject of ocean outfalls, which was gathered by the author in the preparation of this article, is available on request from the editors of CONSULTING ENGINEER.

- True False Most people enjoy a friendly argument.
- True False I sometimes feel that people are staring at me.
- True False My father and I never got along well.



Psychological Testing . . .

A consulting engineer explains employee testing techniques and results in a small firm.

BENNETT COULSON
Consulting Engineer

GOOD JUDGMENT is one of the basic requirements for new personnel in our civil engineering practice. A man who combines this trait with good emotional balance can become a productive member of our engineering team, with a minimum of management support and control. Unlike intelligence, which can be evaluated on the basis of scholastic and work records, these personality traits are sometimes difficult to uncover.

For this reason we decided to embark on a program of psychological testing, not only for new job applicants, but also for our management and key employees. Just as we expect our clients to call on consulting engineers for a solution to their specialized engineering problems, it was our decision to find a psychological consultant who could put his specialized knowledge of human relations to work for us.

"Balanced Personality" Desirable

After investigating the available testing services, we retained the Houston firm of Birkman and Associates, consulting psychologists. This firm has developed an approach to psychological testing which places emphasis on incentive as the major force in vocational success, rather than aptitude and intelligence. Thus, its psychologists are interested in probing both the conscious and unconscious layers of personality in an individual, in an effort to discover what they call "balanced personality." They contend that there is no such thing

as an average personality. Rather, there are personality traits in every individual which either clash or blend. They claim that the individual with clashing personality traits cannot be productive himself, and he may disrupt the whole group around him.

Basically, there is little difference between the successful engineer and the successful physician. Primarily it is a matter of interest and training. However, for either to succeed, there must be present in each a blending of personality traits that allows them to exercise good judgment.

Similarly, there is little difference between the engineer and the draftsman. It is mainly a matter of training, work interest, intelligence, and the goals which an individual has set for himself. The well trained engineer who has no strong tendency toward leadership often may be content to remain a draftsman. Frequently, however, drafting becomes merely a stepping stone for the man with ambition. Thus, it becomes important for us to know something about a man's personality. If we are hiring a draftsman, with no real opportunity for advancement, it is usually more important for us to know what the man's goals are than how well he has been trained.

Psychology's Role

The assumption here is that one or more people in a small organization who lack an understanding of themselves can disrupt the relationship of everyone in the organization. One who does not possess

the integrity or stability to keep his mind on his business will be a constant source of irritation and frustration to the others about him and will bring about a low level of morale among his fellow workers. No person is perfect; but all individuals in the organization must establish a good balance between their strong and weak characteristics if the organization is to function in harmony.

Psychology's role for the consulting engineer, therefore, is to uncover ways and means of tapping the enormous potentials that lie within most human beings. Is Engineer X basically creative, or should he be given more routine assignments? Is this engineer in need of firmer, sterner handling? Is this man working under too much pressure? If so, how can we best relieve the pressure and thus increase productivity?

These are some of the questions that psychology is answering today. The techniques now in use can provide this important information about individual personality differences and needs in a very short time. Sometimes as little as 30 minutes can be adequate. The psychological tests from which the information is obtained are simple to administer. The Birkman method features a questionnaire which is simply a series of 240 easily understood true and false questions. In addition, there may be an intelligence test, a short vocabulary test, and a work interest quiz.

The True-False Questionnaire

The most important test for us was the long true-false questionnaire. The apparent simplicity of such a test is deceiving. Actually, it was developed after years of research and is so designed that it reveals traits of personality rather than intelligence, interest, or aptitude. The test's objective is to gather reliable information on a person — what he thinks about himself and also about other people. Thus, these questions might be used:

I enjoy a friendly argument. True False

Most people enjoy an argument. True False
As simple as these sample questions appear, they are carefully chosen and analyzed, and as part of a large group of questions they can be used to get a good picture of a man's personality. Efforts to make a good impression, with answers calculated to please, fail to affect the test results. The test is designed to reveal these efforts and thus reveal significant personality traits.

After test forms are processed, a very comprehensive analysis, that might loosely be called a profile, is submitted by the psychologist to the employer. Generally it includes a discussion of the individual's strong and weak areas, his characteristic needs on the job, explanations of each of these particular personality needs, and suggestions on

how his immediate superiors can best help him to grow on the job.

Incidentally, it should be pointed out for the benefit of consultants who operate in smaller cities lacking psychological testing staffs that distance is no longer a problem. There is no reason why psychological testing cannot be handled on a mail basis. In fact, the psychologists of Birkman and Associates prefer not to interview the individual personally. They feel that if information is obtained independently by means of the questionnaire, there is less danger of their being influenced in their analysis by surface personality and impressions. With respect to the employee, there lies the added advantage of his knowing that the findings were developed from responses to the questionnaire, independent of any personal impressions on the part of the psychologist, which fact could cancel the benefit to be derived from the testing.

Using the Analysis

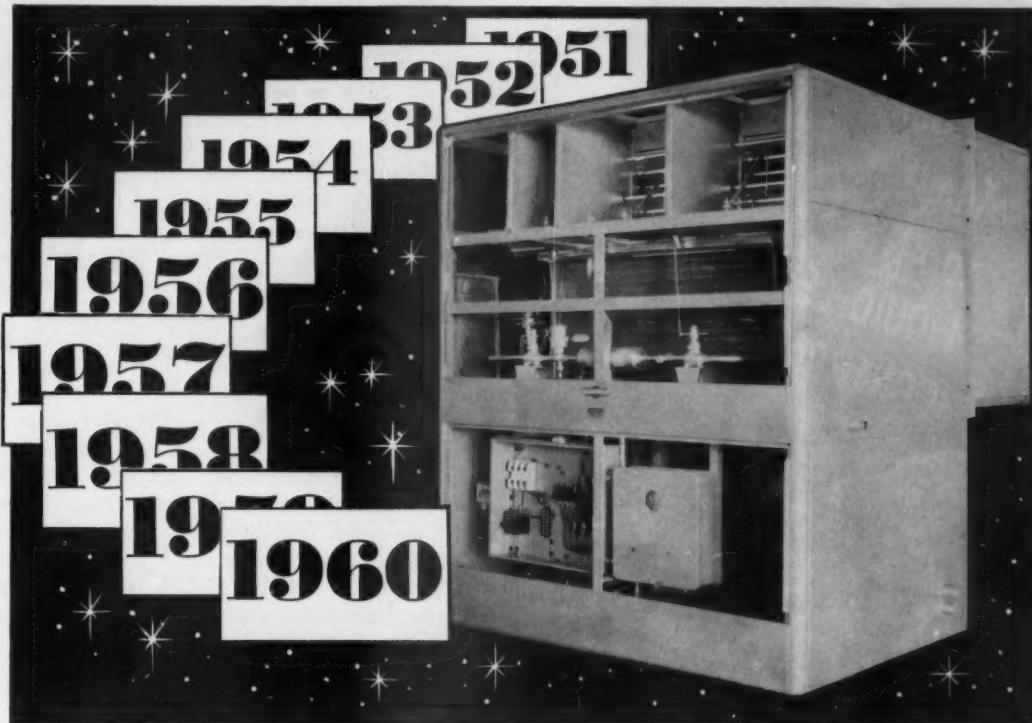
When our firm completed the testing program we received eight or nine pages of pertinent data concerning the individual personalities of each of our six key employees. Additional pages were devoted to an explanation of psychological testing and the specific methods employed.

The following excerpts illustrate the nature of these reports. It appears that Mr. B ". . . has some unusually strong drives which will complicate his relationship with associates and superiors unless their nature is fully understood. Probably the most significant finding of this study is that his strong and weak areas are generally consistent with his present work assignments."

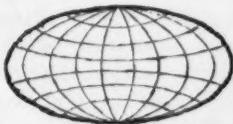
The remainder of the analysis is a further interpretation and explanation of the strong and weak areas and suggests means of directing Mr. B. The report continues, "Need for esteem — appropriate ways should be found to assure him of genuine respect and appreciation. Mr. B is far more sensitive than the average person. Fear of failure or loss of face is one of his most powerful drives toward achievement. His constant, self-conscious concern for the good opinion of others makes him extremely sensitive to the feelings and attitudes of those with whom he associates. He needs respect as an individual, and he also needs to feel that his thoughts, ideas, convictions, and work are respected."

This discourse on the single point of need for esteem points up the real value of the psychologist. Not only does he discover the strong and weak areas of Mr. B, he suggests how the strong can be put to good use, how the weak can be improved.

Another excerpt, one that may strike a familiar note to some consulting engineers, points out that



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Mr. B, ". . . should be encouraged to plan his work carefully and give necessary attention to minor detail. Although Mr. B is capable of attending to necessary detail in areas of immediate interest, his basic nature is to be satisfied with the 'essential meaning' of issues, at the expense of relevant but bothersome detail. Since he is so disinterested in clerical routine, he unconsciously puts off taking care of details. His tendency to let things go can complicate matters when he unexpectedly runs into unforeseen problems. His basic dislike for scheduling and planning can lead to a tendency to change plans, and disrupt his own program and that of others. On the other hand, a lack of underlying project-mindedness is in its highest phase a form of courage."

It was found that Mr. B needs time alone, away from distractions or social pressures; he needs to work more by himself rather than with others; he needs to be active; he needs to work at his own speed; he needs reflection; he needs reassurance.

Of course, these excerpts are only a small part of the complete analysis. Mr. B's true personality is hardly given full justice with this brief glimpse.

What Did We Gain?

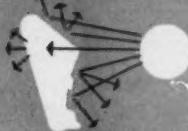
Our primary interest in psychological testing is simply consideration for the future of our firm. It is our desire to provide the best possible environment for our employees and in so doing to lay a firm foundation for our organization so it can withstand future work loads as well as today's projects.

Another thing we desired was to maintain the same quality and caliber in the hiring of new personnel that we felt we had among our present employees. In other words, we wanted to put the testing program to use in the long range planning of the entire organization. Psychological testing seeks out the particular strengths and qualities of those in the organization and spots areas of weakness ("weak links in the chain"); and likewise it reaches out to bring into the firm persons of similar caliber. With the knowledge that the employee or applicant has the necessary intelligence and educational qualifications, we are primarily interested in his being able to work side by side with others and how he can best serve present and potential clients of the firm. We are much more interested in learning his attitude toward life than in determining his I.Q.

The cost of this program has been reasonable. Because we are advised on pertinent questions without personal contact and consultation with the firm member or applicant, our costs have been held to a nominal \$50 per person. We did not make use of the psychological testing program in order to save money but to enable us to work together better as an organization.



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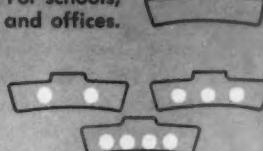


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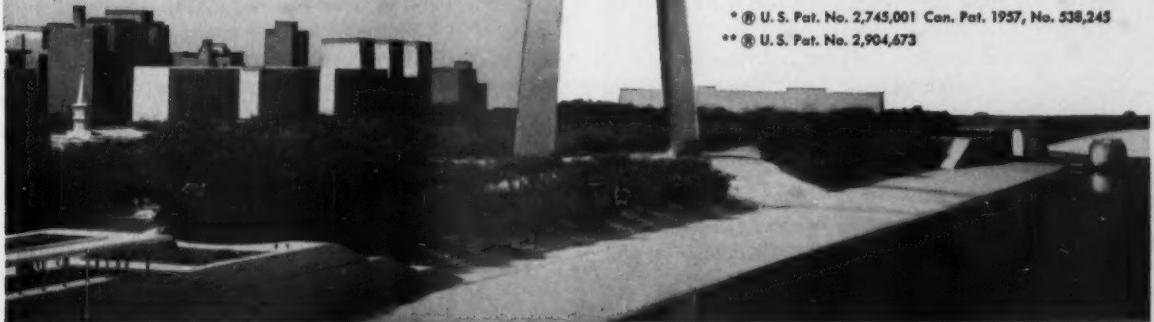


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The Lebanon Tunnel, a part of the old Union Canal, is the oldest existing tunnel in the United States.

Early American Tunnels

RICHARD SANDERS ALLEN

EARLY AMERICAN engineers probably have shown more skill in avoiding the construction of tunnels than they could have exercised in building them. However, the United States still has had its full share of pioneer tunnel builders. They contributed a great deal to the development of modern tunneling methods, and many of their early works, both famous and obscure, exist today.

Unfortunately, the first tunnel ever built in this country was destroyed over a century ago, and its site is now an overgrown open cut. In 1818, the planners of the Schuylkill Navigation Canal, in eastern Pennsylvania, found themselves faced with a 40-ft ridge of red shale which jutted up from the river near Orwigsburg Landing (now Landingville). Only a hundred feet to the west, the unknown canal engineer could probably have eased his waterway around the hill with little trouble. But the promoters needed publicity, and the engineer was a daring soul. He chose to plot

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a 450-ft tunnel — 20-ft wide by 18-ft high — straight through the escarpment. The contractors, three brothers named Fudge, spent three years prying and digging out the shale to these dimensions. Water was let in, and the first boat poled through the tunnel's cool depths in 1821.

With succeeding improvements and enlargements, America's first tunnel gradually was whittled away. In 1856 it was daylighted and became just another rock cut.

The Orwigsburg Tunnel was followed closely by another. Pennsylvania was again the locale, this time at a height of land northeast of Cleona in Lebanon County. Here the Union Canal pierced the slate ridge with a 720-ft tunnel, 18-ft wide by 15-ft high. Called Summit Level or Lebanon Tunnel, it was designed by Canvass White (1790-1834), one of the few canal engineers in America who had ever seen an artificial waterway. He made a point of personally examining the English canals, walking over 2000 miles on the towpaths to do it.

White's masterpiece was opened in June 1827, and later enlarged and shortened to 600 feet in length. Today it is the oldest existing tunnel in the U. S.

Other early canal tunnels, built before 1830, penetrated the ridges of the Alleghenies at Conemaugh and Grant's Hill on the Western Division of the Pennsylvania state works. Paw Paw, one of America's longest canal tunnels, was driven two decades later when the Chesapeake & Ohio waterway eliminated a tortuous five-mile bend in Western Maryland with a 3118-ft rock bore with towpath. In Ohio's Columbiana County, the short-lived Sandy & Beaver Canal also was served by tunnels — one of them a mile long.

Early Railroad Tunnels

Operating with limited motive power, the first railroads were little better off than the canals in surmounting the rugged hills that stood along their routes. Again in Pennsylvania, the state-owned Allegheny Portage Railroad overcame some of these obstacles with a 901-ft tunnel and 10 inclined planes. The tunnel construction began in 1831 and holed through two years later. The project was under the supervision of a competent and youthful engineer, Solomon W. Roberts (1811-82). His pay was \$3 a day.

Miners dug and scraped a passage large enough for the Little Portage railway cars and sectional canal boats to negotiate. Their pay was \$13 a month, plus board. Walled up now, the Portage Railroad tunnel portals still can be examined on a hillside four miles east of Johnstown, Pennsylvania.

With the boom in railroad building during the 1830s, it was natural that more tunnels would be built. Among the pioneer jobs was the Black Rock Tunnel near Phoenixville, Pennsylvania. This 1932-ft bore was put through under the direction of Moncure Robinson (1802-91), chief engineer of the Reading Railroad. Robinson was a small, soft-spoken Virginian already famed for his masterful surveys and plans for the Reading Railroad. At Black Rock he sank several vertical shafts to permit simultaneous tunneling from several points.

Varying in depth from 82- to 139-ft, the vertical shafts were located at the edge of the tunnel bore, rather than directly over its centerline. Robinson reasoned that this method lessened the danger of objects falling down the open shafts and hitting his men. He was probably right, but Hassell Wilson, the assistant in charge, was forced to use candles in the gloom of the shafts to light his instruments and keep the digging in alignment. He complained that he very nearly went blind in the process.

Up in New England, railroad tunneling got off to a late start with a rock bore near Norwich, Connecticut. To design the Norwich & Worcester

Railroad, James P. Kirkwood (1807-77) was imported from his native Scotland. He surveyed and mapped the route, and planned the bridges, buildings, and tunnel. He then left the details of construction to a young fellow Scot, James Laurie (1811-75), who, like Kirkwood, was still in his twenties when he became a full-fledged chief engineer of a railroad.

Laurie hired pick wielders and shovelers, along with some quarry men familiar with rock drilling, and set them all to belaboring the hill. Nineteenth Century rock drilling was a team job, usually handled by groups of three. A driller held the chisel-like wedge and rotated it in the hole, at the same time pouring in water to flush out dust and cool the drill. Two hammermen synchronized powerful blows on the wide top of the drill. Using these holes, pickmen could twist and pry apart the rock. Slow and laborious though it was, this method was enough to eventually create a tunnel.

Explosives Add to Danger

To speed up the tunneling work, black powder and a mixture of saltpeter, sulfur, and charcoal sometimes were used. After drilling, instead of using the holes as access points for pickaxes, they were filled with this explosive and tamped down solid with clay or mud capping. Touching off the charge was accomplished by laying a fine train of powder. Another method was to use a fuse made of a hollow reed, straw, or goose quill filled with tinder. A powderman who lit a powder train or fuse made it his business to depart "instanter." The resulting blast was sure to rock the quiet of the countryside, and many a rock worker was killed or maimed.

Foot by foot Laurie's quarrymen pushed their tunnel through Bundo Hill, a 200-ft bore which



The Bundo Hill bore is New England's first tunnel. It was opened in 1839, north of Norwich, Connecticut.

penetrated solid rock. Complicating the job was the planned curvature of the tunnel, thought to be the first in America so designed. It was opened on September 9, 1839, and though extremely low on clearance, still serves the New Haven Railroad.

Another early northeastern tunnel ran under the busy streets of Salem, Massachusetts. It was dug through a solid clay bank, the soft, wet, gray stuff removable only by brigades of men with shovels and barrows. As they proceeded, the walls were shored with timbers and the tunnel arched and lined with sturdy New Hampshire granite. Young Samuel Nott (1815-99), a missionary's son and self-taught engineer, was in charge of designing this section of the Eastern Railroad, and John A. Carpenter was the contractor.

After well over a century of service, the one-track, low-clearance Salem passage was replaced by a modern tunnel in 1958. It was built with boxed steel frames and concrete. The open cut was dug mainly with clam-shell buckets, but there was still a large tonnage of gray clay dug by manpower.

Open Cut Tunnel at Walpole

Just south of Boston, at Walpole, Massachusetts, is an early example of a tunnel built by a method less risky than holing through. Where the New York & New England Railroad line crosses under the main village street on an angle, an open cut was first dug through the gravelly loam. Sandstone rubble masonry then was used to form a 200-ft arched tube, with neat granite rings at the portals and heavy wing walls to hold back the earth. Covered over with earth, the Walpole Tunnel was opened for traffic in 1848. The pattern for its construction has been duplicated many times since.

Village stores, streets, and a power canal were all squeezed between the hillside and the Connecticut River at Bellows Falls, Vermont. A 400-ft tunnel was the only way the Vermont Valley Railroad could get past this spot, so the road's contractor began to dig in 1851. With the tunnel running diagonally under the town square, black powder could not be used because of the buildings just above. Each outcropping of rock had to be carefully drilled and picked apart with hand labor. Local limestone was quarried and carefully keyed and mitred to form the arched vault of the tunnel ceiling. Fortunately, the builder envisioned larger locomotives, and today the huge Boston & Maine diesels move through with ample clearance.

Another Vermont railroad bore is unique in American tunneling history as the first to be dug through quicksand. A hundred years ago the little Vermont & Canada Railroad wanted an entrance into Burlington, chief port for the inland water commerce of Lake Champlain. It appeared to be an easy matter to dig a cut through the 100-ft ridge north of the city, where for centuries the winds off the lake had been blowing up sand on one side, while the Winooski River had been dropping silt on the other. The ridge seemed solid enough, but it was actually found to be a bank of treacherous, shifting quicksand.

After futile attempts at excavation, the Vermont & Canada gave up thoughts of cutting through, and built an unsatisfactory, winding rail route out of the city to the south. Daniel Linsley, the road's chief engineer, still thought there must be a way to lick the problem, and returned to it frequently.

Linsley knew that ordinary digging was out of the question, because sand filled in as fast as a



The old Salem Tunnel, manually dug through clay, was replaced after over a century of service in 1958.



At Walpole, Massachusetts, a tunnel for the New Haven Railroad was built in 1848, using an open cut.

shoveler could throw it out. But the engineer's eye was attracted to a strange thing. A colony of swallows had built their homes in the sandbank — right along the face of the deserted hole.

According to Linsley's reckoning, the swallows used no particular offensive against the unstable sands, other than mud-packing, wing-beating, and perseverance. Mud packs would not work on a bore of the size the engineer had in mind, but perhaps perseverance might. Watching the swallows arching their wings in their scooped-out homes, Linsley thought of a unique plan for tunneling, and let a \$60,000 contract to get started.

Linsley's Tunneling Shield

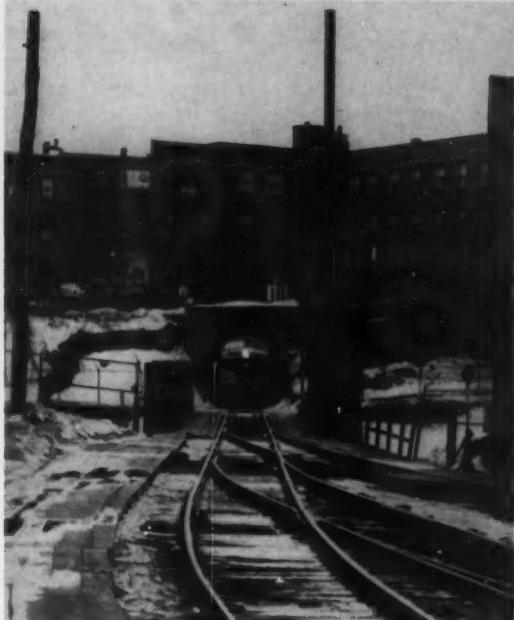
The Vermonter had designed a shield similar to the top half of a locomotive cab, in which holes were bored along a semi-circular arc. Through the holes 8-ft wooden poles were driven into the bank, held tightly together to form an arch. Then the sand beneath them was excavated to make a small vault. This process was repeated again and again.

As fast as their half-circle heading was completed, the tunnelers dug down the sides, so that the excavation resembled a block letter "A" with high bar and rounded top. Over 680,000 bd ft of lumber went into framework to brace the hole as it proceeded, keeping back the creeping quicksand. As soon as there was room, a brick arch in the form of a horseshoe was built up from grade, and the walls between masonry and wooden plank packed solid with concrete.

Engineer Linsley had 85 men at work on the Burlington Tunnel all through the bitter cold winter of 1860-61, with the bore enclosed in canvas to keep out the chilly winds of Lake Champlain. The tunnelers worked 12-hour shifts around the clock — shoveling, scraping, and scooping their way deeper and deeper into the tricky ridge. Right behind them bricklayers and masons labored on the horseshoe-shaped arching. Little stoves furnished heat, and a small gas apparatus threw faint rays of light about the gloomy hole. A pipe system, with a fire kept burning continually outside, created a draft to draw off the foul tunnel air.

In the central portion of the shaft the best progress that could be made through the unpredictable quicksand was about 36 inches a day. However, by using the perseverance of the swallows, the tunnel finally was completed in six months. Linsley's Burlington Tunnel was 340-ft long and followed a four-degree curve.

John Carpenter, contractor for the clay-clogged Salem Tunnel, took on a rock job at North Adams, Massachusetts, in 1859. This was to be known as the "Little Tunnel," and was located under Witts Ledge at the western edge of town. Originally



At Bellows Falls, Vermont, a tunnel for the Boston & Maine Railroad had to be burrowed under the Square.



Quicksand was the obstacle blocking this Vermont tunnel. It was finally built with the aid of a shield.

single track and 430-ft long, the craggy curved bore was dignified by placing dressed granite portals on either end.

Some 30 miles south, in the town of Canaan, New York, a pioneer line from Boston to the West cut through a ridge of the Taconic Range back in 1841. The original tunnel was dug by the Albany & West Stockbridge Railroad through a hill called "Snake Den." Bossed by Capt. John Childe (1802-58), an engineering graduate of West Point, rock drillers, hammermen, blasters, and wheelbarrow boys tackled the limestone-slate of the hill. The 584-ft tunnel was chopped, picked, and blasted out on a curve, with crews working from both ends at the rate of about 53 feet a month. Increased traffic soon called for an enlargement, and a second tunnel was chewed through alongside the first. Because of their proximity to the Massachusetts border, the twins are named State Line Tunnel.

Tunnels Grow Longer

Engineer Childe was soon in action on the Northwestern Virginia Railroad, where the tunneling jobs called for distances of considerably more than 500 feet. This road, which became the Baltimore & Ohio Railroad's extension to its Ohio River goal, had Benjamin H. Latrobe (1806-78) as its chief engineer. Latrobe had over 5000 men and 1250 horses at his disposal for railroad building, as well as practical tunnel men like Captain Childe. His Irish contractors, Lemmon, Gorman, Clark and McMahon, were responsible for blasting 11 tun-

nels under the rugged ranges of western Virginia. Foremost were the Kingwood Tunnel (4138 feet), the Welling (1248½ feet), and the Board Tree (2400 feet). Black powder blasts left these rock bores a bit shaky in spots. In the year 1857 alone the Baltimore & Ohio paid out \$2293.35, just for watching tunnels.

Farther south, Claude Crozet (1790-1864), an ex-military engineer for Napoleon, had his men blast and dig a series of railroad tunnels under Virginia's Blue Ridge. Farther on he found one spot where nature already had hollowed out a natural tunnel large enough to accommodate a rail line. Over the Mason-Dixon Line in Pennsylvania, Oliver W. Barnes drove through the 4500-ft Sand Patch Tunnel at Summit, on the railroad from Cumberland, Maryland, to Pittsburgh.

The old Pennsylvania state-owned Allegheny Portage Railroad, with the first American railroad tunnel, was considered obsolete by the 1850s, and a continuous line was devised which eliminated the original inclined planes. Milnor Roberts, who at 16 had been assistant engineer on the old Lebanon tunnel, planned a new 1800-ft passage farther east, burrowing 135 feet below Sugar Run Gap.

Also anxious to reach Pittsburgh was the cross-state route of the privately-owned Pennsylvania Railroad, being built under the direction of Herman Haupt (1817-1905), another West Point-trained engineer with great ability and drive. Haupt already had supervised the construction of other tunnels on the line; one along the Little Juniata River, Carr's Tunnel west of Latrobe, and the 3612-ft Greensburg Tunnel. At the highest point on the road, above the famous Horseshoe Curve, Haupt and his contractor Thomas Rutter busied their men with a deeper, longer tunnel. Their Summit bore, built simultaneously with that of the Portage Railroad a short distance farther up the mountainside, plowed through Sugar Run Gap with a deeper, 3670-ft passage. Considerable trouble was encountered by the presence of coal seams in the rock. Nearby mine shafts came so close in working the veins of anthracite that they threatened to collapse both the tunnels and the railroads. Today's Pennsylvania Railroad main line uses three tunnels at this spot.

Tunnel Contracting Exclusively

Thomas Rutter, with his brother John, became one of America's first contractors to take on tunnel work exclusively. In addition to their work in Pennsylvania, they drilled and blasted the Harlem Railroad's rock bore at 92nd Street in New York City, a series of 10 tunnels along the Hudson River route of the New York Central, and one for the Housatonic Railroad in Connecticut.



State Line Tunnel has twin bores under the Snake Den, near Canaan, New York, on the Massachusetts border.



West portal of the Hoosac Tunnel under the Berkshires in Massachusetts. Project snuffed out 196 lives.

Up until mid-century, no railroad tunnel had been deemed practical, let alone built, that was over 1-mile long. Yet in 1852 the planners of the Troy & Greenfield line in Massachusetts dreamed of piercing the Berkshire mountain barrier with the Hoosac Tunnel, a smokehole that would stretch for nearly 5 miles. Their visionary plan was part of a grand scheme to connect Boston with Great Lakes shipping by means of an entirely new through route.

Only a few promoters and engineers really believed that the Hoosac Tunnel was a feasible project. Even the first conservative estimate amounted to over \$2 million. John Carpenter, the New England contractor, cautiously suggested it might cost about \$4.50 a cubic yard. A. F. Edwards surveyed the proposed line from Boston clear through to Sackett's Harbor on Lake Ontario, and believed in the practicality of the tunnel. He was banking on a new development in quarry methods. — the boring machine.

"Wilson's Patented Stone Cutting Machine"

This intriguing mechanism was a giant auger to cut through the rock and save all the hammering and picking. An inventor named Wilson had built the machine in South Boston the previous year, at a cost of over \$25,000. It was a 70-ton steam-driven behemoth, with revolving cutters to slice out a 4-ft diameter core.

Engineer Edwards inveigled the railroad company to try the Big Borer on the Hoosac. They put a down payment on the contraption and had it

shipped to the mountain. On a cold November day in 1852 there were spectators from miles around, gathered to witness the first test of "Wilson's Patent Stone-Cutting Machine." Belching steam and smoke, the borer ponderously ground into the flinty granite. It worked smoothly for over an hour, cutting a circle 1-ft deep. Edwards had happy visions of gnawing a hole through old Hoosac in a couple of years. The watchers cheered as the machine, clanking and banging, sliced nobly forward. Then the iron monster suddenly wheezed, coughed, and expired gently against the mountainside. Despite many attempts, it could never be made to run again.

Edwards went hunting a new job, but his accurate plans for the Hoosac tunnel were followed by the dozens of engineers who succeeded him. Digging the 5-mile "Great Bore" was to take 25 years, snuff out 196 lives, and cost well over \$9 million. Associated with it would be many of the men who already had tested their professional skills on America's early tunnels, among them Herman Haupt, James Laurie, and Benjamin H. Latrobe. And this great achievement was to be the proving ground for compressed air drills, safety fuses, and high explosives. The age of modern tunneling was about to begin.

The Hoosac Tunnel marked the end of an era of tunnels blasted out with black powder. Developed to speed work in pushing through the headings was an explosive 10 times more powerful. Its inventor called it nitroglycerine — the forerunner of dynamite. □



Setting the Right Fee

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J. L. BREESE,
Consulting Engineer

PROFESSIONAL CONSCIENCE requires that

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service be rendered when it is seriously sought and genuinely needed.

This implies that a decision to accept or reject an assignment should not be influenced by the size of the client's proposed investment. But consulting engineers find it practically impossible, economically, to adhere to this principle. This indicates that consulting engineers either are not qualified to practice on a truly professional level, or that there is an inherent weakness in their fee system. There is a good deal of evidence to support both possibilities, but the latter is probably more significant. The percentage method of fee determination discourages the consulting engineer from accepting small jobs, and thereby tends to deprive low-cost construction of adequate engineering. When physicians will remove splinters and attorneys will handle minor legal problems, what can potential clients think of consulting engineers who refuse service on jobs below some minimum dollar value?

Aside from the bad public relations resulting from what appears to be engineering snobbery, a large amount of potential work is being passed up. Furthermore, reluctance to render service on small jobs not only encourages "free engineering" and do-it-yourself designs, it leaves no alternatives. The results of these practices are chronicled daily in the newspapers, as improper ventilation, wiring, and structure take their toll of lives. But in spite of all this, engineering firms, even the small ones, seem unanimous in their reluctance to become involved with a small job.

Broadly speaking, the small job can be defined as that job which has a construction cost in the

neighborhood of zero. Note that this definition does not limit the size of a small job to any particular dollar value, for any job could appear to be near zero when viewed by a firm whose average job is many times that size. The same job could be eagerly accepted by a small firm. Thus, a firm-size vs job-size curve continues smoothly downward until it hits a serious discontinuity, namely, at the obviously indivisible one-man firm. The particular range of job sizes that cannot be done profitably by even the smallest firm is a matter of professional concern.

Small Jobs Can Be Complex

Traditionally, the small job is the first test for the new consultant. Unfortunately, it has inherent characteristics that can ruin his practice very rapidly. Low budget requirements and client resistance to quality specifications are common small-job characteristics that make it exasperatingly difficult for the consultant to do his best work. The small job represents business he must rely on to create capital for expansion, yet this class of work often causes his bank balance to diminish more rapidly than it would had he spent the same time on a good vacation. Finally, when he most urgently needs good public relations, the slightest hitch on a small job can create irritation for miles around, of a magnitude that is all out of proportion to the problem. In fact, if there is one general characteristic of the small job, it is that someone always goes away mad.

These difficulties arise because of certain assumptions which are common to design services, even though they actually are contrary to experience. The first assumption is the classical notion, dear to architects and slavishly perpetuated by most engineers in interprofessional practice, that

For the Small Job

Engineer's Dilemma

the total design effort for a project is directly proportional to the construction cost. The second assumption, and one implicitly made by practically every architectural magazine, is that the mechanical and electrical components of small buildings are trivial to the point of being almost beneath notice. But the truth is that although the engineering on small jobs may not be very profound, it is often very complex. The percentage method of fee determination, being essentially a contingent arrangement, cannot possibly provide reasonable compensation for the inevitable time-consuming complications arising on small jobs. However, rather than attempt to modify the system, most of us have simply abandoned the small job client or, at best, considered him merely a stepping stone to more important projects.

Thus, the reasons for the consultant's dread of the small job are clear enough — at least to consulting engineers. The unfortunate thing is that the reasons apparently have not been made clear to the prospective small job client. Returning to the examples of physicians and attorneys, it is evident that they can afford to render small services because they are compensated for their time. In fact, it must be concluded that their system of establishing fees is a very successful one. Otherwise they could not afford to render the minor services which the public demands of them. Why, therefore, can't consulting engineers have their services on small jobs accepted on some basis that will return a fair profit?

For the consulting engineer, the horns of the small job dilemma are apparently an inability to obtain a reasonable fee for this type of work, and a disservice to the profession if it is refused. Unquestionably, even if the fee situation could be



corrected, very few consultants would care to devote their entire career to small jobs, for they are generally not too interesting. Nevertheless, if an equitable fee system for small jobs could be discovered and firmly established, the small firm, at least, would be encouraged to help meet the need for good engineering on low-cost projects.

Follow-Up Time Accumulates

Since experience has indicated that the percentage method fails when applied to the small job, it seems logical to use this experience to establish a proper fee system. Most firms have found that an apparent profit on one job does not insure a similar profit for a series of jobs of the same size. This seems to come about because of the manner in which the engineering work is divided. Assuming every job to be composed of conference time, design time, and follow-up time, it soon becomes evident that the follow-up component may continue indefinitely.

Thus, if a new one-man office completes the design of its first job with what appears to be a reasonable profit, the consultant may conclude that a series of jobs of this same size will produce, as a whole, the same percentage of profit. Assuming that he continues to obtain one job after another, each of the same size, he soon finds that he no longer can turn out each of these jobs in the same time that he recorded the first. A certain amount of follow-up time from that job has added to his work load while he is trying to get out the second. On the third job, he is harassed by follow-up time from both previous jobs.

This consumption of the consultant's time continues to be compounded until he is forced to hire

an assistant. At this rate, it would not be an exaggeration to predict that the one-man office could grow to a four-man office in the period of a year, even though job size and job volume remained constant. Therefore, the percentage of profit for the year—if any at all—would be a good deal less than it appeared to be on the first job. From this discouraging experience, a closer examination of the three components certainly is indicated.

Design Time Reflects Job Size

Of the three job components, design time is the only one that seems to show any hope of being directly proportional to the job size. Conference time, according to most engineer's experience is closely predicted by Parkinson's Law¹, which states that the time spent on any conference is inversely proportional to the cost of the project under discussion. Follow-up time includes checking shop drawings, making inspections, and becoming generally immersed in the inevitable flow of little details which float behind every job like debris in the wake of a ship.

As illustrated in the example of vanishing profits, follow-up time can increase without limit unless some restrictions are agreed upon early in the engineer-client negotiations. As a matter of fact, if follow-up time could be predicted, it probably would be found that it would have to be measured by its half life since the consultant never can be really sure that he has spent the last hour on any of his jobs. And when conference time and follow-up time are large in comparison to design time, any fee system related solely to job size will fail to produce an adequate profit.

How to Determine Profit Erosion

The general success of the percentage method does not indicate that it fits all jobs, but rather that jobs which it does not fit are simply avoided. Every office probably has a fair idea of the minimum job size that can be accepted at the standard office percentage. In an effort to determine the actual profit erosion which takes place on jobs below this minimum size, when work is charged on the normal office percentage, the curves in Fig. 1 have been plotted from actual job records. Curve A is a straight line representing the theoretical relationship between profit and job size as postulated by a fixed percentage fee system. Curve B is the actual relationship as indicated by job records.

Although the plotted points were badly scattered, there was enough evidence to indicate that a larger sampling would justify the assumption that Curve B is an hyperbola. The form of its equation for these particular asymptotes, developed by E. Wood², turns out to be, $P_a = KS - (KC^2 \div S)$,

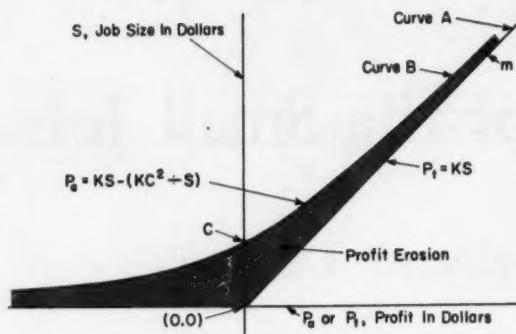


Fig. 1 — Profit erosion determined by plotting a fixed fee percentage against actual job records.

where P_a is the actual profit, S the job size, C a constant, and K a conversion factor. But the theoretical profit, P_t , is given by the formula, $P_t = KS$, which is the equation for Curve A. Thus, the difference between theoretical and actual profit is simply $KC^2 \div S$.

The ordinate intercept of Curve B is the point C, and this represents the particular job size where the normal office fee, by percentage method, would return a profit of zero. Point m is established by the minimum job size that can be handled at a fair profit when using the normal office fee. Below point m, profit erosion sets in; below point C, this erosion results in negative profits, that is losses; and as the job size approaches zero, the losses increase indefinitely.

Breese's Law of Profit Erosion

These basic data have led to a general statement which, for lack of a better name, will be called Breese's Law of Profit Erosion.

For job sizes which are in the neighborhood of zero, a fee system which postulates that engineering effort is a direct function of construction cost will result in a profit which is less than that predicted by the system, and this difference will vary inversely with the construction cost.

The substance of this law is well known, but by reducing experience to this form a practical method for determining minimum fees is suggested. Let us see how this would work out for the small office in interprofessional practice where experience has shown that a \$5000 building subcontract returns zero profit when handled at the normal office percentage. For the sake of illustration, a normal fee of 4 percent is used. The value for K is set at one half of 4 percent on the theory that a reasonable profit is 100 percent of total office costs. Note that for a \$20,000 subcontract, P_a is close enough to P_t



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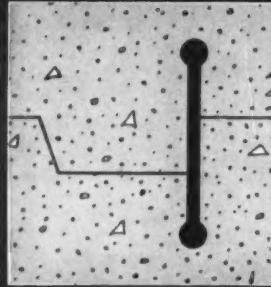
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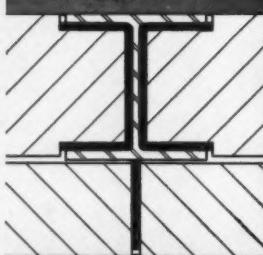
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to consider that this size job determines the point m. For any job below this size the fee equals $0.04S + (0.02C^2 \div S)$.

Minimum Fee Schedule When C = \$5000

Job Size S	Normal Fee 0.04S	Profit Erosion (0.02C ² ÷ S)	Required Fee 0.04S + (0.02C ² ÷ S)
\$20,000	\$800	\$25.00	\$825.00
15,000	600	33.33	633.33
10,000	400	50.00	450.00
8,000	320	62.50	382.50
5,000	200	100.00	300.00
Below 5,000			Hourly Basis

For the hypothetical firm in this example, the schedule indicates that the required fee for jobs below \$5000 will begin to rise above the fee required for the \$5000 job. Few consultants who have worked on projects of that small size will deny that this increase is justified; but in order that the client have some control over the amount of money spent for professional services, it probably would be well to work on an hourly basis.

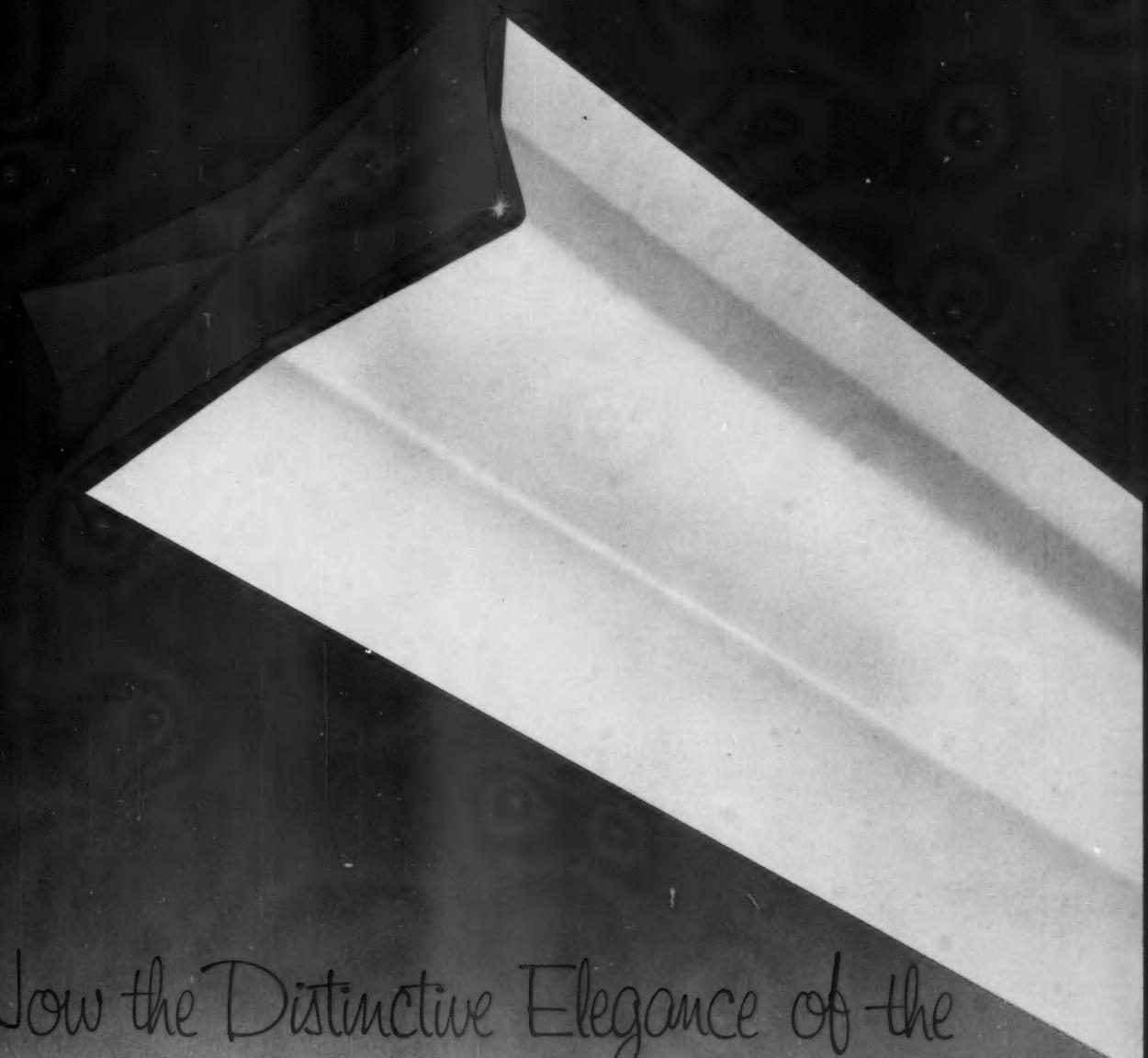
Small Jobs Neglected

In all probability, just the mere mention of jobs of this infinitesimal size will make most consulting engineers' blood run cold. It might be argued, and validly so, that any search for a fee schedule applicable to this class of work is a waste of time, since most small-job clients would surely bolt at paying the required fees. So long as the value of engineering is judged solely by the size of the projects to which it is applied, this situation will continue, and many small jobs which require good engineering will be neglected. But it is difficult to imagine who, if not the consultant himself, can convince the prospective small job client of the value of engineering services.

For the consultant who is interested in developing a small job practice, the story of the milliner's customer may serve as a guide. According to it, a young woman was interested in buying a certain hat which she needed desperately for an important function. The hat, styled in the highest fashion of the time, was little more than a few twists of ribbon arranged in an imaginative pattern. The price was \$50. The young woman was outraged, claiming that \$50 was a ridiculous price to pay for a few bits of ribbon. But the sale was made when the milliner replied, "The ribbons, madam, are free." □ □

References

1. Parkinson's Law, Parkinson, C. Northcote, Houghton Mifflin Co., Publishers, Boston, Massachusetts.
2. Structural Consulting Engineer, Santa Fe, New Mexico.



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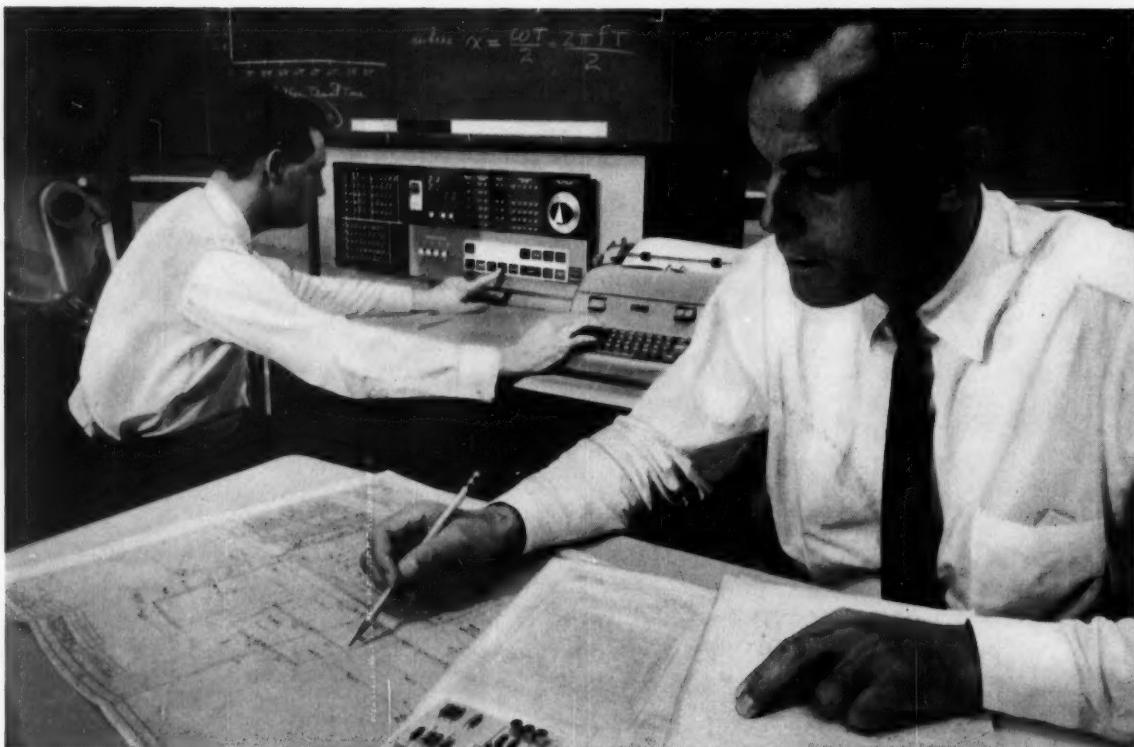
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Report From Denmark

G. PAUL SORBER



The old castle is in Helsingør, or Elsinore, as Hamlet had it, though this is a later model. Considerably more recent are these Copenhagen apartments just now being occupied.

DANSK INGENIORFORENING (Danish Engineer's Association) has about 8000 members, including all types and branches — civil, mechanical, electrical, and chemical. Within this general organization are from 1500 to 2000 engineers who are employed by about 200 consulting firms. These men comprise the Radgivende Ingeniorforening (Consulting Engineering Association), a separate division of the DIF which elects its own officers and deals specifically with the problems of consultants. About 15 percent of this membership is scattered all over the world, at work on projects in 55 different countries. Ove Guldberg is executive secretary of both the Engineer's Association and the Consulting Engineering Association.

Headquarters for the Danish engineering societies and their publications is Ingeniorhuset, a six-storied structure in Copenhagen. It provides a restaurant, a private club, a bar, a billiard room, a meeting room — anything, in fact, that has nothing to do with engineering. It is a standing joke among Danish engineers that Ingeniorhuset is the only place you can go with your new secretary, without being caught by a fellow engineer.

Surprisingly enough, the Danes are able to support three engineering publications, even with only a 4.5 million population. *Ingenioren*, International Edition, is printed quarterly in English and contains articles on original research, development,

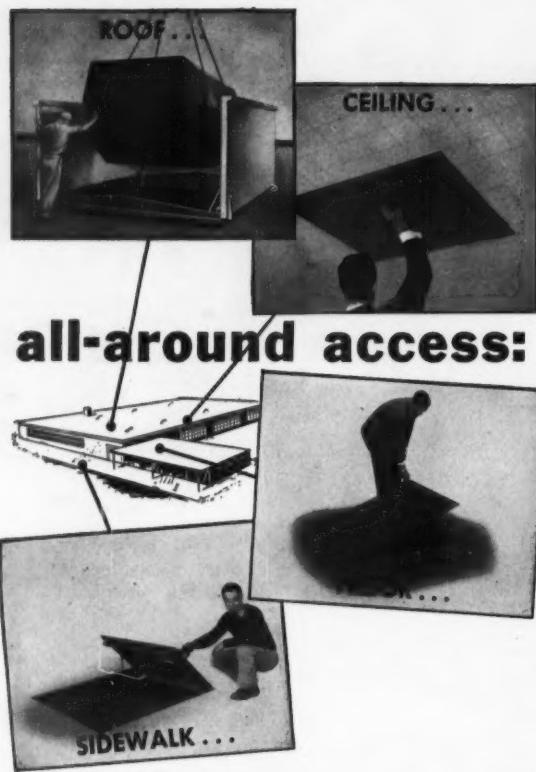
and design by Danes. *Ingenioren*, B Edition, is a semimonthly printed in Danish, covering current projects in both Denmark and abroad. *Ingenioren Ugeblad* is a weekly edition in tabloid newspaper form, with up-to-date news on engineering subjects. It is printed in Danish. All of these publications are widely circulated, and subscriptions from outside the country are welcomed.

Code of Ethics

Attendance at the scheduled engineering society meetings is poor. Reportedly, the majority includes the society officers and, of course, their employees, plus a few fledgling engineers just out of the University of Copenhagen. However, things do seem to get done, for example, publication of a DIF booklet entitled, "Dansk Ingeniorforenings Regler for Radgivende Ingeniorvirksomhed" — quite a mouthful even for a Dane. Actually, it is the equivalent of a code of ethics, with one section devoted specifically to ethics and one to so-called "normal" practices. The section on ethics includes the following:

"A DIF member, engaging in consulting work or undertaking to work as an advisor or consultant to a client, must observe the following rules of conduct with client and colleague:

- ¶ "The engineer must be the client's independent, confidential agent."
- ¶ "The engineer must not accept compensation from competing clients and must not under any circum-



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stances, either directly or indirectly, accept or demand commissions, rebates (kickbacks), and the like, which are not exclusively to the client's benefit. Should the consulting engineer have any business, family, or other association with contractors or suppliers, which could be subject to question, the client must be fully advised of the relationship.

¶ "The engineer gives his orders in the client's name and can act as an intermediary in compensating contractors or suppliers only by approving the amount to be paid them by the client.

¶ "The engineer must compete with his colleagues only in an ethical manner.

"He must not, directly or indirectly, damage a colleague's reputation, or unfairly underbid or unfairly exploit the advantages of an association or connection with another organization.

"He must not take over a colleague's job after it has commenced, unless he has made sure that the relationship between client and colleague is liquidated or is ended by a court decision.

¶ "At the conclusion of agreements on the performance of work as an advisory engineer, the engineer should follow the 'Usual Practices' (Almindelige Bestemmelser) as closely as possible.

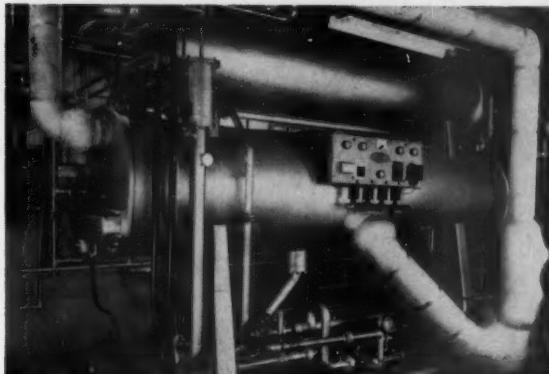
¶ "The above rules apply to the engineer's activities in Denmark. Members who perform consulting services in foreign countries are permitted to operate under the rules in force in that nation."

While these "regulations" are quite broad, they do form a set of basic principles which are adhered to by the consulting engineers, almost without exception. The supplementary "Usual Practices" form a more specific code of practices which outline the specific duties and obligations of the consulting engineer in regard to the client, supervisor, contractors, suppliers, foremen, accounting procedures, draftsmen and drawings, billing procedures, and disputes with clients and colleagues. The Almindelige Bestemmelser has been translated into English and is available to engineers in other countries. It consists of 12 articles of conduct and procedure.

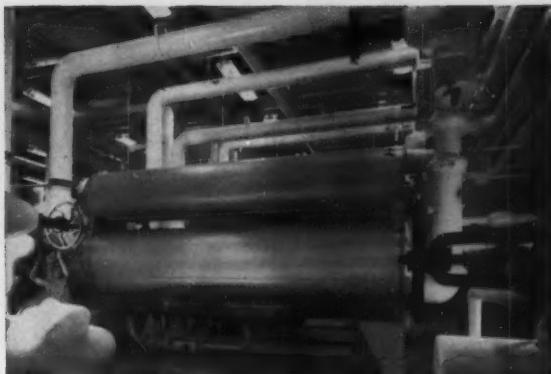
Arbitration of Disputes

Questions on proper procedure and on violations of the Etiske Regler or Almindelige Bestemmelser which are not clearly a matter for the courts are appealed to a board of arbitration in the DIF's Ministry of Public Works. This board is formed of five members from the various departments of the DIF, including the legal department, and the decisions "by a proper majority" are considered to be "final and binding" on the parties concerned.

Minor problems of engineer or client can be referred to the DIF's Opinion and Information Committee for clarification of existing rules and opinions on unusual situations. □



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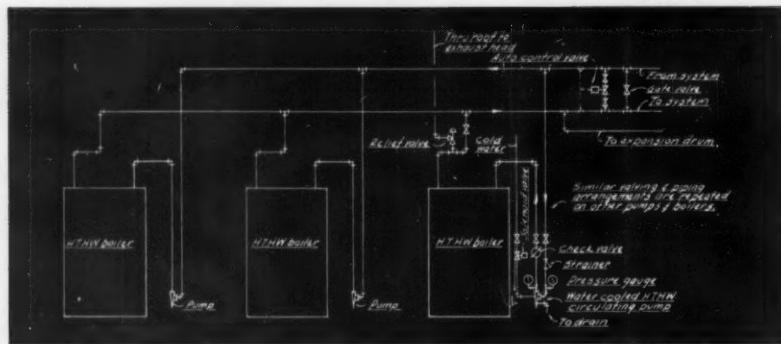
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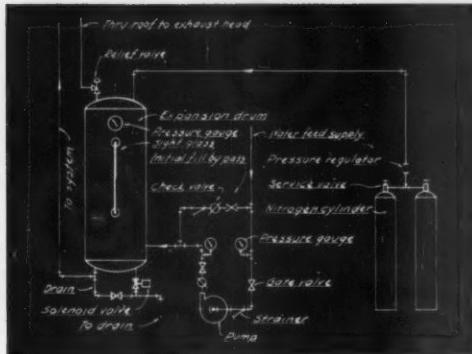
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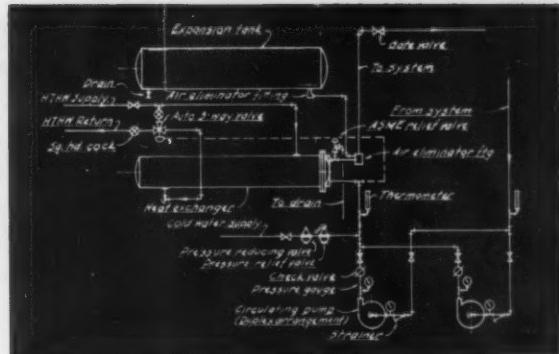
NO HEATING SYSTEM can be expected to satisfy all the varying conditions represented by the many sizes and types of shopping centers that are or may be located from Miami to St. Paul. So, in discussing the specification of heating systems for shopping centers, we must start from some basic assumptions as to type and location.

Since we must make assumptions, we also can assume the existence of an architect who has been clued by the owner as to the nature and extent of the project. And we then can assume a client-architect-engineer conference at which the following preliminary description of the project evolves.

¶ Multiple unit shopping center, located in the northern part of the United States in a 70 to 80 F design temperature difference area on a 50-acre site of relatively flat terrain.



Expansion drum and necessary tank piping for a nitrogen charged HTHW central heating system.



Heat exchanger piping system for transfer of heat from high to low temperature hot water pipelines.

the responsibility of the lessees. The problem before us, then, is one of heating system design and specifications for this project.

Heating System Design Approach

The first possibility to be considered is the use of separate heating systems for each lessee. While there are advantages, the disadvantages far outweigh them. Equipment would be duplicated in each unit; service would be a major problem for the owners; each unit would have to have its own stack; lessees undoubtedly would want different fuels (creating a delivery problem); and each plant would occupy valuable floor space. True, each lessee would be responsible for the payment of his own heating bill, however, this can be accomplished by simpler and better means.

Having rejected separate systems, we move on to a consideration of a central plant—a remotely located boiler house, with a system of distribution piping serving the several units. There are a number of possibilities to be studied.

Low pressure steam would call for buried piping extending along the edges of the area, close to the buildings, with runouts entering the units as required. This system might serve the purpose, but here again the problems are major. Low pressure steam piping must be pitched and dripped, pumping stations for condensate removal would have to be furnished at numerous points along the length of the runoff piping, regrading would be a necessity, and temperature drop within the mains themselves would be considerable. Piping would have to be large, and maintenance would be expensive.

High pressure steam would have only one advantage over low pressure steam; the pipe sizes would be reduced. Other disadvantages present themselves. Insurance rates would be higher, and the steam flashing possibility would be present.

Low temperature hot water could, at first glance, meet our basic requirements. Piping runs would be straight and level, there would be no condensate problems, but main sizes would be large, and temperature drop would be extreme.

After examining the basic virtues and faults of these systems, we should next consider the one other system available to us and see if it would satisfy the conditions we require.

High temperature hot water would allow us to have piping that would be relatively small and installed straight and level. Labor costs would be minimized and installation could proceed rapidly. With a reverse return piping principle, temperature drop would be negligible, especially with a high temperature delivery.

Let us now decide upon temperature and pressure. Should we specify 400 F, 300 F, or 250 F; and what about pressure, 150, 100 or 50 psi? We could, for instance, consider 400 F hot water and have extremely small pipe sizes but this selection would be a poor one because of the higher operating pressures required by the higher temperature. Extra heavy pipe and fittings would have to be installed, along with more expensive valves. Using 250 F water would be questionable because its characteristics so closely approach that of low temperature water.

High Temperature Hot Water Advantageous

Examination of temperature-pressure tables indicates that a boiler of proper design can deliver 320 F hot water at approximately 100 psig. Taking full advantage of this high delivery temperature, we might expect to have a 100 F drop through our heat transfer equipment.

Piping would leave the central plant and extend to the various units. Each unit or building would be furnished with a convertor, for water-to-water

transfer, and a system of piping, conveying water at 220 F with a drop of 30 F. Each convertor would be installed with a three-way mixing valve on its high temperature side to permit the maintaining of a constant head on the high temperature circulating pumps.

Each store or unit could be heated in any one of several ways. The smaller units might employ direct radiation; the larger self-contained buildings might use large volume air handling units with duct work and diffusers, air handling units being provided with space for cooling coils if the lessee desired their installation. The auto-wash would require an air handling unit for quick drying with door areas being heated with unit heaters. The professional building could be served with individual room units so arranged as to provide winter heating and summer cooling by means of circulating hot or chilled water.

Each convertor station would be self-contained and have its own water supply and flow meter. The rate of flow through the unit on its high temperature side would be the determining factor in the amount the tenant would be charged for the heat used during any period. In addition, each convertor station would have the pumps required for proper water circulation within its building. If multiple zones were required, they could be furnished with little difficulty. Each pump would be duplicated on a stand-by basis to minimize chances of shutdown.

There are, at this time, a number of boilers available that might fulfill the needs of this particular project. Selection could be made readily in accordance with the particular likes or dislikes of the consulting engineer. Let us say that we select a boiler sold and serviced in the particular area where construction is contemplated, for locally available service is important.

How Many Boilers Required?

After deciding which type of boiler to use we next must determine how many boilers we would require. Would one of ample capacity be sufficient? What about stand-by operation? Should we not consider boiler shutdown for proper maintenance? Would two boilers, each sized for the full amount of load, provide all we desire? Why not three boilers, each capable of delivering one-half the normal load? In this manner, one boiler could very well carry the load during the mild weather seasons, the second could be put into service when outdoor temperature dictated, and the third could be for shutdown. In this manner boiler operation could be alternated with two boilers always available for immediate service.

Each boiler would require the installation of a high temperature hot water pump for circulating

water through the main piping system serving the stores and units. Pumps should be water cooled and inter-piped into one main leaving the central plant. These pumps need not be duplicated for stand-by purposes, since each boiler-burner-pump assembly is a stand-by unit in itself.

What Type Pressure Charge?

Now we must determine which type of pressure charge we want to employ. Compressed air could be used, but we would encounter certain detrimental characteristics which would come with its selection. Air yields to water by giving up some of its oxygen, and this aspect alone could make it a hazardous choice.

A nitrogen charged system has many advantages. The entire system requires full pressurization, and this is accomplished through a vertical pressure tank which also acts as an expansion tank and boiler water feed receiver. The tank should be connected into the piping system ahead of the pumps. Extreme care should be used in the sizing of this tank. The volume of the boilers, piping, and convertors must be considered in their entirety. Nitrogen is fed into the tank directly from pressure bottles through pressure regulating valves, thereby keeping the entire system under a constant pressure. In putting the system into operation it is necessary to boil it out to permit the initial charge of water to deaerate itself. After this the nitrogen charge is introduced.

Whenever possible, the distribution piping should be installed in tunnels to facilitate maintenance and service work. Then, repairs can be made within the tunnels rather than by digging up parking areas. Directly buried piping also does not readily reveal exact areas of leakage for small defects.

Regardless of the method of installation selected, the piping must be insulated, and expansion joints and anchors must be provided. In addition, pipe guides should be used to prevent the possibility of excessive flexure. The tunnel can be exploited still further in that it may be used for domestic cold water distribution. Schedule 40 piping can be used, along with standard pattern 125 fittings and valves, but the merits of extra heavy piping should be studied.

This system would be low in initial cost, equal in operating costs, and low in maintenance cost, when compared with steam or low temperature hot water. Insurance rates would be comparable to low temperature hot water on the plant and lower than normal on the stores and units, for combustion equipment is not contained within them. While a maintenance staff would have to be trained to operate and maintain the system, a licensed operator would not be required, since the system contains high pressure water rather than steam. □

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IN ADDITION, Tote System retains the flexibility of unit containers:

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- *Flexibility in Plant Layout and Procedures:* Tote System can be adapted easily to future requirements. Plant layouts can be changed simply by re-locating discharge stations. Operations can be expanded merely by procuring additional Bins. And the Bins can be used interchangeably for different products.

Consulting engineers are invited to call upon us for engineering data and all assistance in the interests of their clients. Write for complete catalog.

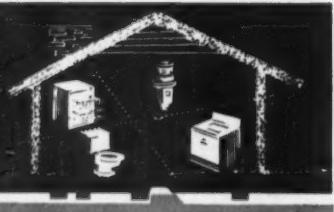
TOTE SYSTEM, INC.

626 So. 7th, Beatrice, Nebraska

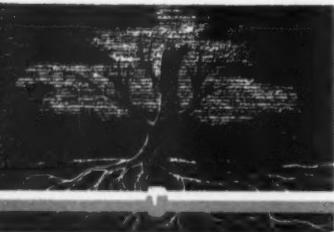
*Tote and Tote System
Reg. U.S. Pat. Off.



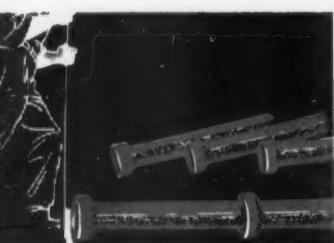
SMOOTHER—Due to the self-centering feature of the Amvit joint and the super-smooth interior surface of the pipe, a lower Kutters "n" value can be used in design.



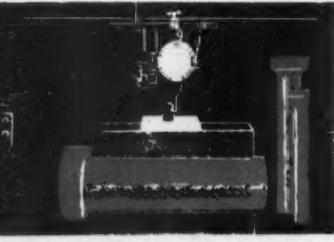
ACID RESISTANT—The interior surface of Amvit Jointed Clay Pipe cannot be harmed by sewage, chemicals, or hot liquids. No competitive materials can make this statement.



ROOTPROOF—Amvit is a compression type joint on the ball and socket principle. When the joint is made nothing can enter the line.



SPEEDS INSTALLATION—Delivered to the job site ready for immediate installation, Amvit is a true mechanical joint. It is pliable, permitting reasonable deflection.



STRONGER—Amvit Jointed Clay Pipe far exceeds A.S.T.M. specifications because it is produced by the most modern manufacturing techniques with rigid quality controls.



Amvit Jointed Clay Pipe proved

NOW, A NEW TO SERVE THE

The Factory-made Plastic Mechanical Joint for quick, low-cost installation

Never before has a product gained immediate and wide acceptance and usage in such a short period of time. In the past few years over 100,000 miles of Amvit Jointed Clay Pipe have been installed across the country with outstanding results.

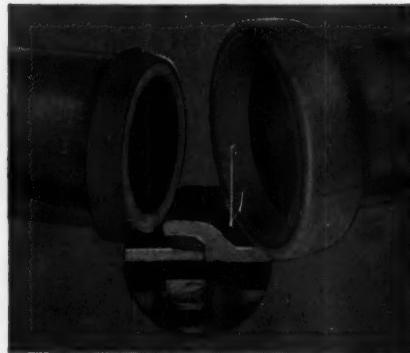
The Amvit Joint is manufactured from plasticized resins of polyvinyl chloride. No other combination of materials is used or needed. It is applied on the pipe at the factory by a special manufacturing process and is delivered to the job site ready for immediate installation. No special tools or equipment are needed and the line can be installed in adverse weather.

The design of the Amvit Joint is based on the ball and socket principle. The material on the spigot end is a convex shape, with the bell end in a concave shape. This permits easy and rapid installation.

When the joint is made, it reaches maximum compression which results in a really tight line, thus preventing infiltration, exfiltration and root penetration. A large savings in both pumping and treatment plant costs can be achieved.

The design of the Amvit Joint assures self-centering which gives a smoother invert and better flow characteristics. This, in turn, results in a trouble-free line with less maintenance and repair.

Due to the tightness of the joint, no foreign matter such as sand, stones or dirt can enter the line. This permits a larger capacity in the pipe for transmittal of sewage alone. Since infiltration is practically eliminated, the sanitary sewer does not have to carry anything other than that for which it was designed. This feature permits the use of smaller sized



FOOLPROOF JOINT—Amvit Joint is a true mechanical joint made from plasticized resins of polyvinyl chloride. It is a compression type joint on the ball and socket principle. When the joint is made, the surfaces of both bell and spigot rings are in constant high compression.

pipe in many instances and will reduce the material cost.

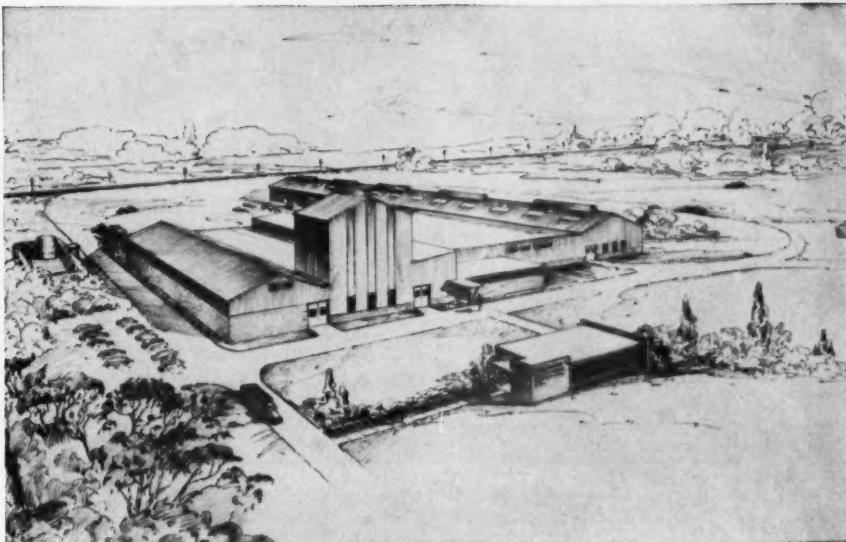
For more information on how Amvit can help cut your sewer project costs, write or call American Vitrified Products Company, at our office nearest you.

See our Amvit Display at the following conventions:

- MARCH—Ohio Society of Professional Engineers
- APRIL—New Jersey Society of Professional Engineers
- MAY—Michigan Society of Professional Engineers
- MAY—Pennsylvania Society of Professional Engineers
- JUNE—National Society of Professional Engineers
- JUNE—National Plumbing and Heating Exposition

in service across the nation!

JERSEY PLANT EAST COAST



PRODUCTION STARTS MAY 1st

With a capacity of more than 350,000 feet of clay pipe a month, this new plant will serve the needs of Amvit Jointed Clay Pipe on the East Coast and New England areas. The most advanced production techniques in the industry will produce never-before-equalled quality of clay pipe and factory-made joints.

REGIONAL OFFICES: Cleveland, TO 1-6750 • Chicago, ST 2-5243 • Detroit, GA 1-1940
Los Angeles, EL 9-4535 • Milwaukee, HO 6-4990 • St. Louis, HA 9-5400
Somerville, N. J., FO 9-4378

AMERICAN VITRIFIED PRODUCTS COMPANY

NATIONAL CITY BANK BUILDING, Cleveland, Ohio



GLAS-GLAZ PIPE—Here's a new product that has everything. Vitrified clay pipe in long five-foot lengths, the rootproof Amvit Joint, glass lined inside and out.



FITTINGS—More than 35 different fittings are available with or without the Amvit Joint. There are fittings to solve every problem.



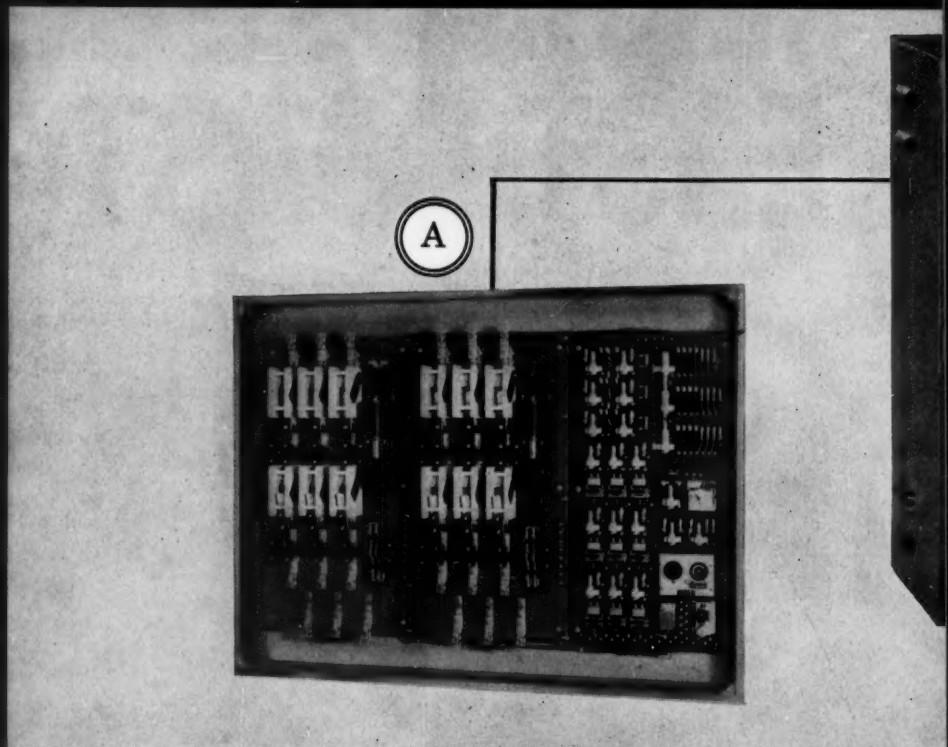
FLUE LININGS—America's flue linings conform to A.S.T.M. specifications and are available in all sizes and dimensions.



WALL COPING—American produces four styles of wall coping to suit any architectural needs. Easily installed, the coping virtually becomes part of the structure.



LINER PLATES—Curved liner plates will protect concrete structures from corrosion. They are used on pipe 36" to 144" diameter. Flat liner plates are used in box culverts, abutments and wherever abrasive action is encountered.



Here's how ASCO control system operates . . .

ASCO Automatic Transfer Switches, with built in selected time delay of $\frac{1}{80}$ to 3 seconds, ignore momentary outages caused by transient conditions—thus protect generating

equipment from false starts. However, once a sustained outage is detected, ASCO Control Systems put standby power in action—fast. Follow the cycle, step by step . . .



STEP 1 The instant a sustained outage is detected, a contact on the ASCO Automatic Transfer Switch (A) closes.



STEP 2 This energizes the ASCO Automatic Engine Starting Control (B), which opens the fuel control device on the generator and cuts in batteries to energize the starting motor and crank the engine (C).

Four on-off cranking cycles are provided. When the engine fires, the starting control automatically disconnects the cranking control.



STEP 3 When standby power source reaches proper voltage and frequency, the transfer switch transfers the load to the electric plant. Time of transfer— $1/80$ to $1/6$ of a second!

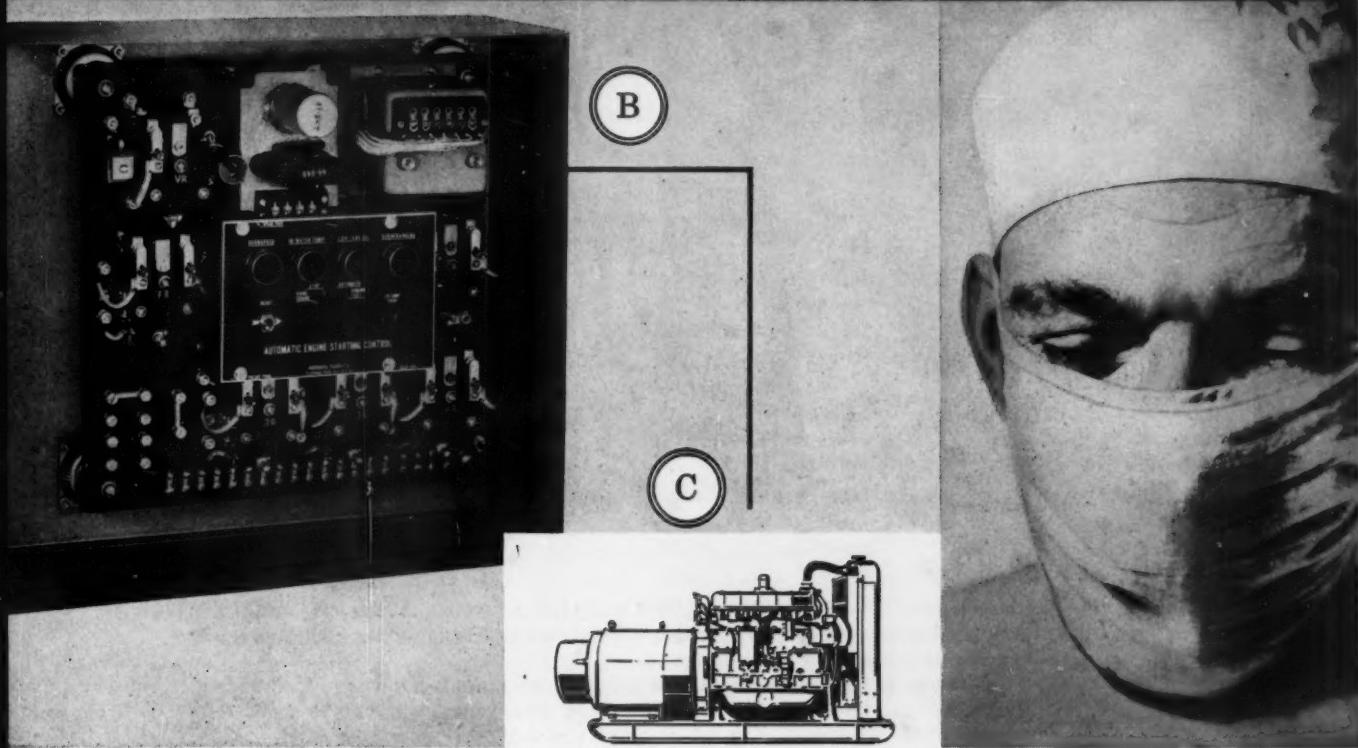
When normal power is restored, the ASCO Transfer Switch returns the load to its original feeder lines. The Starting Control then causes the electric plant to shut down.

shaped for '60 . . .

the NEW DUNHAM-BUSH 'LSBC'

...a Low Silhouette Blower Condenser

that offers high



For Dependable Standby Power, ASCO designs and manufactures a complete line of emergency power and electric plant control equipment. In addition to Automatic Transfer Switches and Automatic Engine Starting Controls, this includes:

Solenoid Valves: For air starting applications, and for controlling the flow of cooling water, fuel oil and other liquids and gases.

Battery Chargers: To keep starting batteries charged, ready for engine starting.

Solenoids: For fuel control devices, operating shutters

for engine cooling, and other electric plant applications.
Load Demand Controls: To automatically start engine when load is applied; stop it when load is removed.

For Detailed Information write for:

Catalog 57-S1 - Automatic Transfer Switches

Catalog 57-S5 - Solenoids

Catalog 57-S6 - Electric Plant Controls (including battery chargers)

Catalog No. 25 - Solenoid Valves

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ASCO Electromagnetic Control

Automatic Switch Co. 50-CC HANOVER RD., FLORHAM PARK, N. J. FRONTIER 7-4600

AUTOMATIC TRANSFER SWITCHES • SOLENOID VALVES • ELECTROMAGNETIC CONTROL

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California Consultants
Meet at Ojai

RALPH S. TORGERSON

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the NEW DUNHAM-BUSH 'LSBC'

...a Low Silhouette Blower Condenser

that offers high
performance and exceptional
installation flexibility



Inner-Fin Construction

The shape of the Dunham-Bush 'LSBC' really has a function . . . the low lines of this new air cooled blower condenser give it an important application/installation superiority over similar units of different design.

Because its new engineered shape ensures safe pounds-per-square-foot loading, the 'LSBC' can be installed virtually anywhere on any roof, without the costly reinforcement of roof members usually necessary to support heavier units. And, the low, compact 'LSBC' is easily accommodated within minimum space, yet has the operational and construction features to meet the most rigid performance demands. Air movement is up and out, meaning minimum noise rating.

Other major features include a high efficiency inner-fin condenser coil with less internal volume and therefore smaller refrigerant charge . . . drip-proof, NEMA frame, grease-lubed ball bearing type motors, with an adjustable base to facilitate belt tension adjustment.

The 'LSBC' is available in a variety of circuits. Models range from 5 to 53.5 tons.

For further information, write for Form No. 7011-1, or call the Dunham-Bush sales engineer near you.

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California Consultants Meet at Ojai

RALPH S. TORGERSON

West Coast Editorial Representative

A Report from the West Coast

A STIMULATING PROGRAM of future activities was outlined by President John Blume for the Consulting Engineers Association of California at the annual meeting at the Ojai Valley Inn, Ojai, California.

The objectives listed were:

- ¶ Maintain and expand the present position of the consulting engineer with city, county, and other local government agencies, working primarily with the large cities, since their precedent often is followed by other agencies.
- ¶ Maintain the status of the Field Bill in the school program.
- ¶ Expand the activities of private consulting engineers in semipublic works, such as are now being handled by large corporations acting for Federal and other agencies.
- ¶ Maintain and expand the consulting engineer's position with various Federal agencies.
- ¶ Maintain and expand the consulting engineers' position with various large corporations.
- ¶ Establish relationships with others and assemble data for a future approach to the Civil Service problem in California.
- ¶ Promote the consulting engineer as the prime design contractor on engineering works as opposed to a subcontractual status under non-engineers.
- ¶ Take indicated action on such matters as employer-employee re-

lationships, competitive bidding, "free engineering," fees and standards, work by nonprofit agencies, work by college departments or professors, and professional practice and ethical procedures.

Other subjects to be given consideration later are:

- ¶ Collaboration with the Civil Engineers and Land Surveyors, who are also employers.
- ¶ Collaboration with other groups on specific matters, such as with the AIA on the Field Bill preservation.
- ¶ Collaboration with the Producers' Council, perhaps with revenue-producing exhibits at CEAC conventions and meetings.
- ¶ Revenue producing advertising in CEAC bulletins.
- ¶ San Diego and Sacramento area groups with monthly meetings.
- ¶ Scholarships, awards, and college and high school counseling.
- ¶ A CEAC Los Angeles office.
- ¶ A speakers' group to address college and other students about professionalism and opportunities in the consulting field.

Legislation

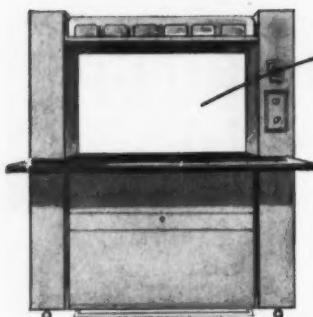
A panel on legislation, consisting of Philip W. Helsley, president of the California Legislative Council of Professional Engineers; Foster K. Sampson, CEAC delegate to CLCPE; and Joseph Sheffet, former president of the Structural

Engineers Association of California and CEAC member, discussed ways and means of collaborating in a more effective legislation program. A continued legislative effort will be made to secure mandatory registration for mechanical and electrical engineers which is now merely permissive.

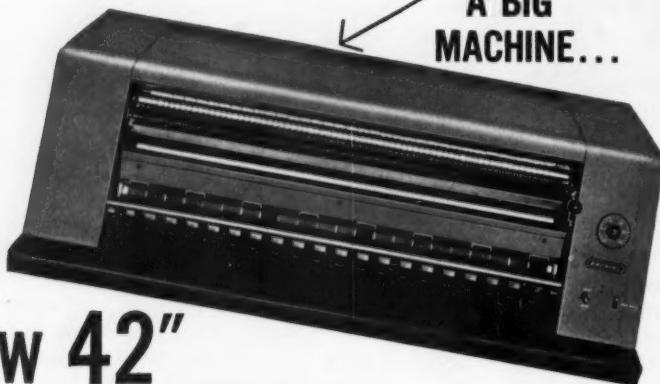
The California Council of AIA has suggested that the present Architects-Engineers Conference Committee now functioning on legislative problems in an advisory capacity be clothed with additional power to select legal counsel to jointly represent the engineers and architects. The proposal was voted down in favor of continuing as a joint advisory group.

Code Problem

President J. Marx Ayres of the Los Angeles area Consulting Mechanical Engineers Association told about the efforts of his group to secure recognition in the new Heating, Ventilating, and Air Conditioning Code by requiring that all mechanical engineering drawings be signed by a registered mechanical engineer. The architects have opposed the inclusion of such a requirement, contending that as prime contractors they have the responsibility for signing all drawings. The mechanical engineers hold that they alone are qualified



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NEW 42" TABLE MODEL WHITEPRINTER!

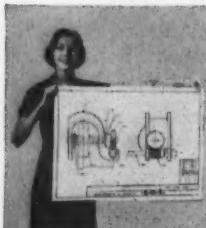
Bruning's new table-size Copyflex Model 320 gives you big machine capacity and performance at a price that puts many a big machine to shame! It's the perfect whiteprinter for firms and departments with *big* tracings—but with *small* reproduction budgets, cramped machine space, or both.

The amazing Model 320 gives you practically everything important you'd look for in a big machine . . . 42" printing width . . . mechanical speed up to 25 fpm . . . complete development of all types of materials at single pass through the machine at any machine speed . . . simple, one-knob speed control. Add to those the exclusive Copyflex advantages: fume-free operation, no vents, no plumbing. And, finally, to win the hearts of all, the 320 produces sharp, black-on-white prints at the low cost of only 1½ cents per square foot!

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to certify that such drawings and specifications are correct and therefore must sign or reject them.

In an attempt to find some way out of the impasse between the two groups, the Los Angeles Chamber of Commerce appointed a committee comprising William T. Wright, of the architect-engineer firm of Kistner, Wright and Wright; C. Day Woodford, of Woodford and Bernard, architects; and Ralph Westcott, Holladay and Westcott, mechanical engineers. A compromise was worked out whereby architects and contractors would agree to attach a statement, where applicable, that the drawings and specifications had been prepared by a registered mechanical engineer. Considerable discussion developed over the situation, most of it sympathetic to the position taken by the Los Angeles mechanical engineers. However, it was finally voted to approve the compromise in the belief that it would be better to obtain "half a loaf" rather than none at all. Continued controversy might jeopardize future efforts to gain more recognition for the mechanical engineers.

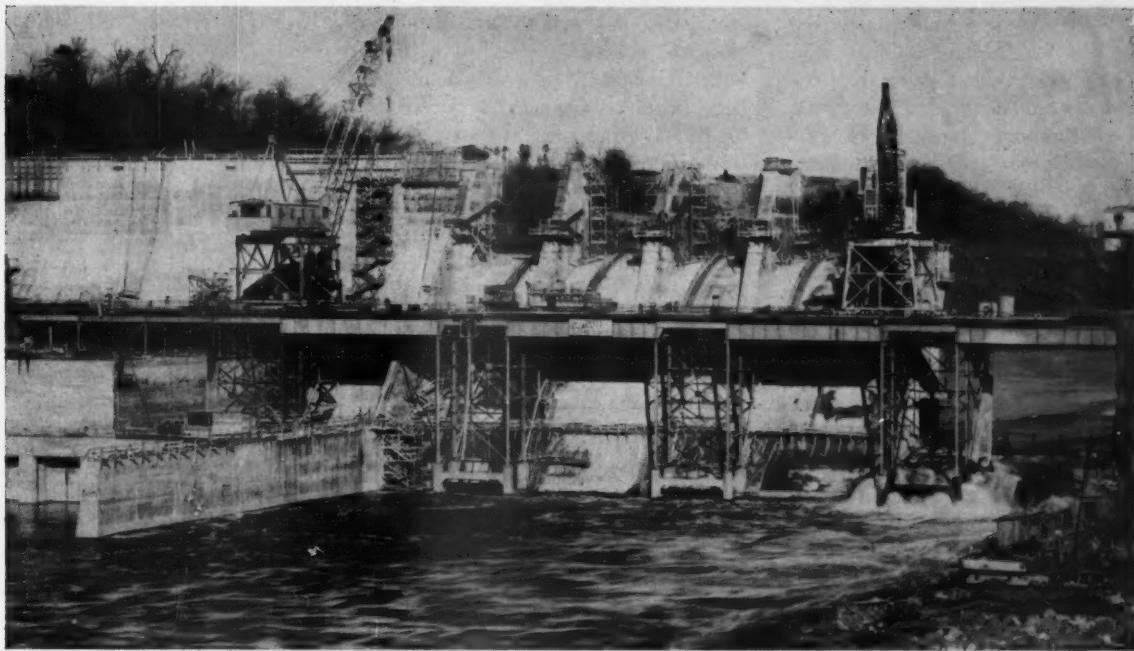
Electrical Group Functions

Sheldon W. Swickard, vice president of the Los Angeles Area Consulting Electrical Engineers' Association, described the activities of this group. There is no attempt to enter into state-wide problems. The only function of this group is to discuss local problems.

The local area group does not have functions that overlap the activities of CEAC, but in some instances has handled local situations with the blessing of the state association. The local group includes both CEAC members and non-members, and it has helped increase CEAC membership.

Engineer-Architect Cooperation

Tom Simonson, chairman of the San Francisco Bay area Mechanical-Electrical Committee, reviewed the activities of this committee,



Clyde Whirley No. CW-3264 on Douglas Dam job.
Also shown is No. CW-3266, now in use at
Widows Creek Steam Plant near Stevenson, Ala.

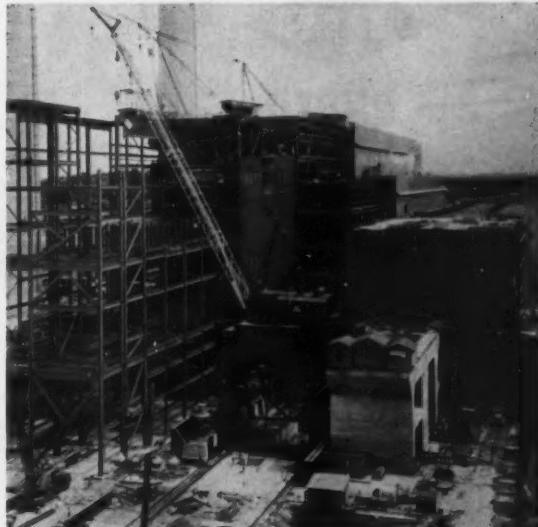
Performance record of Crane No. CW-3264 shows why

Clyde Whirleys are best for dam construction

The severest appraisal of value of a machine is its record of performance . . . its use and re-use on work for which it has been engineered. Continued re-use over many years writes a record of longevity of useful and profitable service such as this record of Clyde Whirley No. CW-3264:

- 1940 Received new at Cherokee Dam near Jefferson City, Tenn.
- 1942 Douglas Dam near Dandridge, Tenn.
- 1943 Fontana Dam near Bryson City, N. C.
- 1946 Sold. Used at Davis Dam near Kingsman, Ariz.
- 1950 Re-purchased by original owner. Used at Boone Dam near Elizabethton, Tenn.
- 1952 Fort Patrick Henry Dam near Kingsport, Tenn.
- 1953 Gallatin Steam Plant near Gallatin, Tenn. through 1959.
- 1960 Colbert Steam Plant near Tuscumbia, Ala.

Pre-World War II and into the 'sixties! Re-purchased by the original owner! What better recommendation for the quality engineering and rugged and dependable construction of Clyde Whirleys . . . or any other material handling equipment that bears the Clyde trademark?



Clyde Whirley No. CW-3264 at work on the Gallatin Steam Plant. Boom length has been increased to 167'. Gantry has been increased to 62' and will be increased to 95' for Colbert Steam Plant job. Hoist motor size has not been increased.

. . . and No. CW-3264 is still in the prime of its youth!

CLYDE IRON WORKS, Inc.

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which grew out of charges by the architects that mechanical and electrical drawings were in many instances inadequate. As a result, the Minimum Standards of Performance for the Design, Selection, and Installation of Mechanical and Electrical Work in Buildings was drawn up by a Construction Liaison Committee, representing engineers, architects and contractor groups. This action has resulted in much better relations with the

architects. The mechanical and electrical committee, consisting of both CEAC and nonmembers, has been dissolved since it has served its primary purpose. However, it can be reconstituted as a local committee of CEAC and remains on standby status to meet any similar problem that may arise.

Problems With State Agencies

M. J. Pregnoff reported for his committee on problems arising out of

the excessive checking of plans by the California Division of Architecture. This caused costly delays and also involved invasion of the engineers' design responsibility.

Commissioner Ralph S. McLean of the California State Building Standards Commission told about the problems involving variable standards of state and local government bodies and the efforts being made toward standardization. Under the present situation, compliance with the requirement of one state agency may result in violation of another agency's standard.

Engineering Costs

Robert M. Kennedy presented an analysis of the problem created by rapidly increasing engineering costs with relatively fixed fees. He said that the engineering profession is faced with three alternatives. It can increase man-hour efficiency through labor-saving devices or other methods, increase fees, or scrimp on the quality of work—which is unthinkable. So much of total engineering cost is represented by fixed costs that there is little area for cost cutting, but it is this area that needs attention.

Pete Serrell pointed to the need for greater employee productivity. Al Paquette called attention to the government departments building up big organizations, using salaries and attractive fringe benefits as an inducement. Tom Simonson and David Narver referred to unionized labor in the building and construction trades, which has aggravated the salary and fee problem for consulting engineers. Bill Moore said that the best solution would be to seek higher fees.

Intraprofessional Services

A report on a proposed reference service was given by William W. Moore. This service would provide a confidential file on the reliability of clients in meeting obligations.

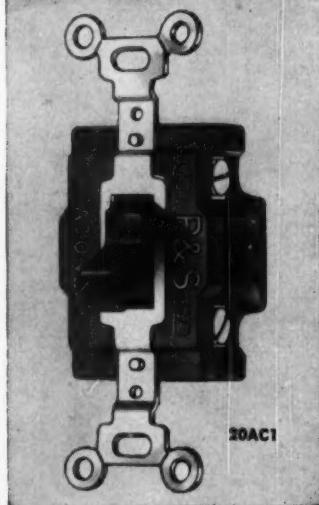
Frank Alderman listed the advantages of a proposed special listing service. This service would take



- Extra large terminal screws.
- Back or side wired.
- Extra large silver buttons.
- Can be used to full rated capacity on inductive loads.

Send for complete catalog, Dept CE-36

- Heavy plastic body.
- Contacts in upright position mounted at point of least vibration.
- Available in 15 and 20 Amp. types.



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MAKE THE COMPLETE JOB COMPLETELY P&S

New fuel cut-out control by Reliance

Pipe one device for double protection

and add alarm for approaching low water level if desired...



Reliance Levalarm EA-100P

Using but one water chamber — one set of pipes to boiler — this new Reliance Fuel Cut-out and Alarm control gives you two efficient devices in one.

At one end (right hand above) a positive float-operated switch cut-out; at the opposite end, an electrode-type control using U.L.-approved transformer-relay hook-up — completely independent of the float-type control but employs a common water chamber.

Check these possible use-combinations of the Levalarm EA-100P:

1. Dual fuel cut-out control.
2. Float-operated fuel cut-out and electrode-operated low water level alarm.
3. Electrode-operated fuel cut-out and float-operated low water alarm.
4. Float-operated fuel cut-out and electrode-operated fuel cut-out and electrode-operated low water alarm.

This Levalarm is the convenient answer in cases where two independent fuel cut-outs are required.

And this Levalarm provides outstanding additional safety to the operation of factory assembled boilers.

Write today for full description of this new safety device.

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John Morley Co., San Francisco 7

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Spotswood Parker & Co., Atlanta 13

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W. P. Nevins Co., Chicago 26

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DeHaven Engineering Co., Indianapolis 4

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LOUISIANA
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Paul B. Huyette Co., Inc., New York City 17

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OKLAHOMA
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Reliance

care of requests coming to the association for firms which would be interested in providing special engineering service. No organized association procedure is now available to handle these inquiries.

G. L. Gendler presented his report on a technical personnel pool. This proposed pool, operating through CEAC, would serve as a clearing house, making available trained engineering personnel from one member firm to another member firm which needed help on a rush job. A mutually satisfactory procedure for payment and release of employees would be governed by rules set up by the association.

Salaries and Fringe Benefits

Employment practices also received considerable attention, with George R. Maurer presenting a table showing a comparison of

employee salaries and benefits in 1959. The comparison, based on a CEAC committee survey, is between pay for certain classes of employees of consulting engineer firms and pay for equivalent level employees in government and other types of organizations. Consulting firms in other sections of the country should note the results, for they may have the same problem.

The table, shown at the bottom of this page, deals with salaries of engineers and draftsmen as defined in groups A through G. The full pay for each of these positions on a state-wide basis is established as 100 in column 1. This column includes not only hourly pay but any additional pay to these employees. All other columns are compared directly with this column 1. Column 2, for example, shows the hourly basic pay for each of these

classes of employees. Then, columns 3, 4, 5, and 6 are breakdowns for Northern and Southern California with and without bonus. Column 7 compares the state of California; column 8 the city and county of San Francisco; column 9 the county of Alameda; column 10 the city of Oakland; and column 11 the 12th District U.S. Civil Service. Organization A and organization B, appearing in columns 12 and 13, are two private enterprise groups. One of these is a utility, one a manufacturing plant. Column 14 shows an average of columns 7 through 13, which are the nonconsulting engineer columns.

Vacations, sick leave, and paid holidays also are shown in the bottom part of the table. The 44-day sick leave allowed by the county of Alameda (column 9) after five years of employment is not a typographical error.

EMPLOYEE SALARIES AND BENEFITS — 1959 . . . IN CONSULTING FIRMS

Position	1 State-wide	2 State-wide (Hourly Basis)	3 Northern Area	4 Southern Area	5 Northern (Incl. Bonus)	6 Southern (Incl. Bonus)
	Consulting Engineers Association Offices					
A Top Engineering Designer (Probably licensed, long experience, could open own office)	100	90	98	102	109	110
B Engineering Designer (College graduate, 10 years experience)	100	96	100	100	107	104
C Junior Engineering Designer (College graduate, 5 years experience)	100	99	100	100	—	104
D Beginning Designer & Draftsman (Starting salary)	100	91	100	100	—	106
E Top Engineering Draftsman	100	107	101	99	109	113
F Average Engineering Draftsman	100	105	100	99	106	115
G Beginning Engineering Draftsman	100	103	100	100	—	115
Paid Vacations (working days per year)						
After 1 year		9.9	9.9			
After 5 years		11.0	11.0			
After 10 years		12.4	12.5			
Paid Sick Leave (working days per year)						
After 1 year		10	9.5			
After 5 years		10	9.5			
Paid Holidays			6.4			

Notes — All salaries are with relation to Column 1 as base 100.

graphical error. In fact, the policy is that if the employee taking this sick leave is not needed on his job, then this sick leave may be doubled to 88 days.

It is obvious that in California, at least, civil service and other government employees are not underpaid with relation to consulting engineer employees and are not much underpaid even in relation to private industry. Consulting engineer figures do not look too good, and instead of the various government organizations complaining that they cannot hire good engineers and technicians because their civil service salaries are too low, it looks as though they could take men from consulting engineer firms on just a straight pay basis.

It was agreed at the California Association meeting that these figures do not look too good for con-

sulting firms, and that they are going to have to face the fact that their over-all pay scale looks low and undoubtedly will have to be raised in the months ahead.

Luncheon Addresses

CEC President Ralph Westcott's luncheon address pointed out the expansion of the Council's activities, and its growth to 27 state and section members. Westcott also touched upon the NSPE Functional Group activity and pointed out that since NSPE is an organization for individual engineers, largely from private industry, that it could not function like CEC which represents firms and principals similar to the Chamber of Commerce. He reviewed the increasing need for public relations activity.

Hunter Hughes, editor of CONSULTING ENGINEER, in another

luncheon address, told about the amazing career of Isambard Kingdom Brunel, who designed the Thames Tunnel, the Great Western Railroad, and a large iron-clad, propeller driven steam ship.

New Officers

Officers elected by CEAC for 1960 are: president, Frank E. Alderman, Los Angeles; vice president, Thomas R. Simonson, San Francisco; and secretary-treasurer, Hugh B. Brewster, Fresno. Other directors are: Engle F. Randolph, Long Beach; Jonathan G. Wright, San Francisco; Robert Kennedy, San Francisco; Dudley Deane, San Francisco; Burt Goodenough, Sacramento; William R. Ropp, Los Angeles; and Peter V. H. Serrell, Los Angeles. Past president John Blume also becomes a director under the new bylaws. ▲▲

. . . IN VARIOUS GOVERNMENTAL UNITS AND PRIVATE ORGANIZATIONS

7 State of California	8 City & County of San Francisco	9 County of Alameda	10 City of Oakland	11 U. S. Civil Service (12th District)	12 Private Organization "A"	13 Private Organization "B"	14 Average of Columns 7 to 13
SE 116 CE, ME 110	105	98	98	94	104	105	104
115	112	104	107	99	112	118	110
114	104	94	104	102	115	101	105
109	108	104	114	107	122	95	108
99	96	90	98	79	—	97	93
96	103	91	88	85	—	96	93
102	105	—	—	96	—	103	101
15	10	11	11	13	10	10	11.4
15	15	15	15	20	15	10	15.0
15	15	15	15	26	15		16.8
12	10	22	12	13	15	12	13.7
12	10	44	12	13	15	12	16.9
12	12	12	12	8	9	8	10.4

Columns 7 to 13 are the approximate average of the 3 to 5 year salary range of each position.

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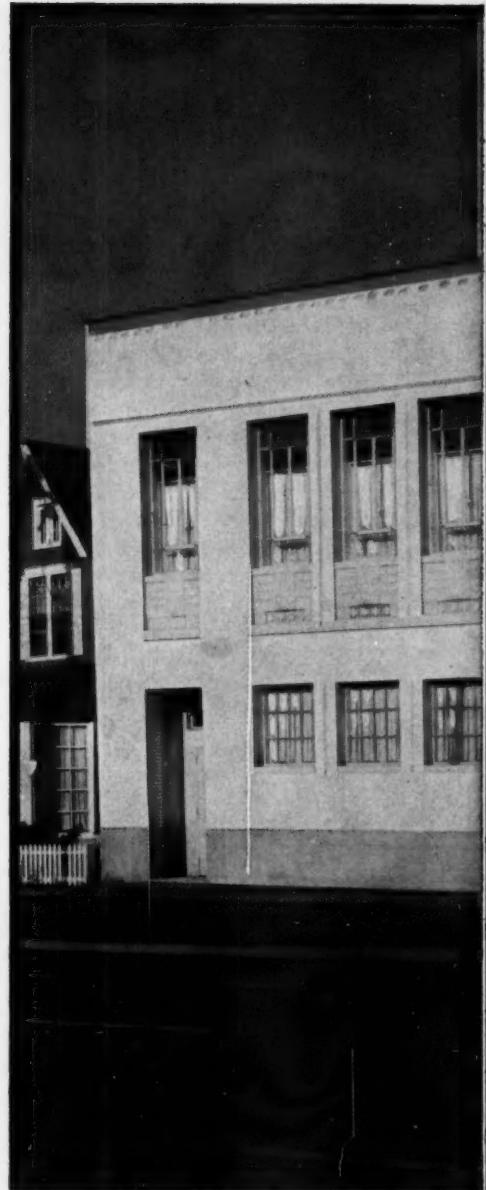
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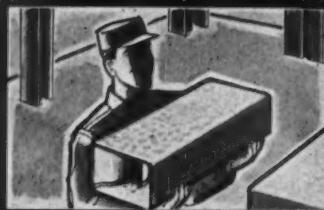
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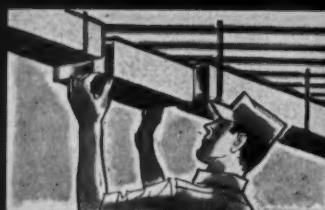
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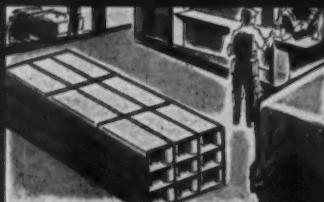
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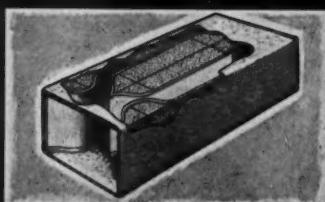
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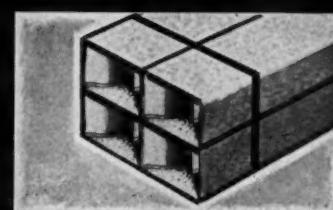
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Field Notes

MARJORIE ODEN,
Eastern Editor

Pennsylvania Investigates Comptroller General's Report

THE COMPTROLLER GENERAL has released another report telling why state highway departments should not make extensive use of consulting engineers, and more are to come. They are to be released in the next fiscal year, starting July 1, according to George Staples, who is responsible for them.

The latest report, covering Pennsylvania, Maryland, and West Virginia, resulted in a hearing before Pennsylvania's Senate and House State Highways Committee. The committee chairman, George N. Wade, explained that since Pennsylvania's highway department was the recipient of most of the Comptroller General's criticism, the Pennsylvania lawmakers wanted an opportunity to see for themselves, if the accusations were warranted.

After the hearing, Representative Harry R. J. Comer, chairman of the House Highways Committee, said the hearings showed the highway department is doing a good job and termed the Comptroller General's report "unwarranted."

ASF Testifies

Where there is trouble for the consulting engineer, the Automotive Safety Foundation seems to be close at hand. Carl E. Fritts, ASF vice president in charge of engineering, was called to testify in Pennsylvania, since the Comptroller

General's report leaned so heavily on ASF material.

The Comptroller General also was invited to appear at the hearing or to send a representative, but he declined. "After weighing all pertinent considerations, we do not believe it would be appropriate for a representative of our office to appear and testify in a public hearing before a committee of a state legislature," Campbell explained in a letter. But he offered to meet individually with any of the Pennsylvania legislators in Washington.

Quoting the Report

The December report, which had been completed more than a year before it was released, states:

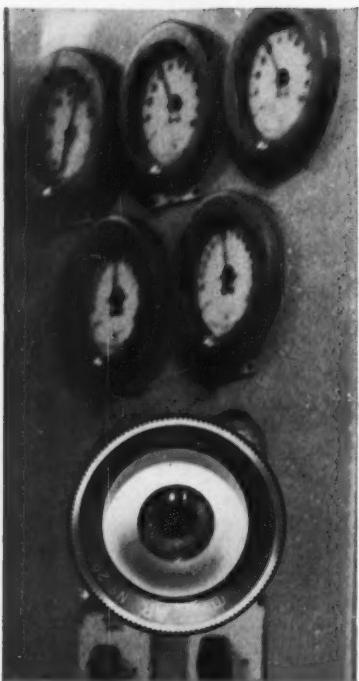
"The use of consulting engineers results in additional cost to the states and the Federal Government, by reason of the overhead and profit included in the fees normally charged by such firms. If all required engineering services were performed by the respective state highway departments, there would be no element of profit in highway engineering costs, and, by regulation, state highway department overhead is not a highway cost eligible for Federal participation. It might be well for the Bureau to consider the advisability of limiting Federal participation in consultant contracts, for services

that should be customarily performed by the state highway departments, to the direct costs of such contracts.

"The Bureau advises that work under the expanded highway program could not have gotten off the ground if consulting engineers had not been utilized in many states. Regarding costs, the Bureau claims that state use of consulting engineers for certain aspects of the highway program, particularly in urban areas, has made available experts not otherwise obtainable and has increased the value of the dollars invested in actual construction. This claim is not responsive to our point which deals with the regular types of engineering, rather than with specialized services relating to bridges and other complex structures. It is our view that the extensive use by some states of outside consulting engineers for the usual types of engineering work, which in other states is done by state-employed engineers, substantially and unnecessarily increases engineering costs and results in an avoidable inequity among the states in Federal participation in these costs.

"We recommend that the Federal Highway Administrator initiate a complete study of the extent to which states are relying on consulting engineering firms to per-





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form usual types of engineering work and the additional costs of the program resulting therefrom and determine whether a reasonable enforcement of the law and regulations can be effected . . . We believe, however, that the apparent lack of compatibility of existing legislation with the widespread use of consultant engineering should not be ignored."

GAO Explains

Before attending the hearing in Harrisburg, CONSULTING ENGINEER interviewed George Staples, Associate Director of the Civil Accounting and Auditing Division, General Accounting Office, and author of this report.

Staples explained that the reason the GAO is criticizing the extensive use of consulting engineers by state highway departments on Federal aid projects is because of the method of payment. When a consulting engineer designs a Federal aid project, the Federal government has to pay a portion of the consultant's fees. The fees include the engineer's overhead and a margin of profit. If the Federal aid design work is done by state personnel, the Federal government pays only direct engineering costs. As Staples puts it:

"We are not concerned with the overhead of state highway departments. Besides, percentages alone mean nothing. The law requires state highway departments to be organized properly to handle Federal aid projects, and Federal regulations specifically restrict the use of consulting engineers. Consequently, there is no basis on which the Federal government should pay overhead on work by a consulting engineer when it was intended we would have to pay only direct engineering costs of such work."

"Besides," Staples added, "some states are more efficient than others. Even in large consulting engineering firms you find some good ones and some bad ones. I will not presume to pass on relative costs.

All we are directly concerned with is what the Federal government reimburses."

Clarifies "Unnecessary Cost"

Staples then was asked about the GAO report's reference to "substantially and unnecessarily increased engineering costs" when work is handled by consultants.

"Our statement on increased engineering cost refers to cost to the Federal government in terms of its participating share, and it comes about by reason of the difference in the basis of reimbursement by the Federal government as already explained."

Further Amplification

Staples was asked how the GAO happened to quote so extensively from the Pennsylvania Automotive Safety Foundation report while ignoring the West Virginia report.

"The Pennsylvania report was called to our attention. The West Virginia report was not."

Of all the Safety Foundation reports, Pennsylvania's is the most critical of consulting engineers. Here are some quotations from the West Virginia report, which criticized the highway department and not the consulting engineers:

"Many inadequacies were found in present Commission accounting procedures. Record keeping, cost analysis, and fund accountability should be centralized within the Department on a practical, accurate, and comprehensive basis.

"The newly opened West Virginia Turnpike is a graphic demonstration of the difficulties and high cost of constructing a modern highway in the State. Construction costs alone averaged more than \$1 million per mile.

"Past practices have resulted in interference in programming of funds, demoralization of personnel, and inefficient operation, with a consequent reduction in the value of highway expenditures."

The GAO report pointed out that in West Virginia "only about

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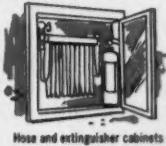
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10 percent of the state's project engineers and very few of the construction inspectors were registered or graduate engineers."

Staples said, "In building up the state highway departments, the states should, of course, get qualified people. We made no detailed study of the caliber of highway department personnel. It would not be our function to say highway personnel is not qualified to handle a job."

ASF Testifies

Fritts, of the Automotive Safety Foundation, made one of the most unenlightening witnesses at the Pennsylvania hearings. It was interesting to note the questions he did not answer.

He began the testimony by pointing out that he had not even seen the GAO report until the week before the hearing. Following are excerpts from the hearing record:

Senator Wade: The Comptroller General claims that use of consulting engineering firms will result in "substantially and unnecessarily" increased engineering costs in Pennsylvania's highway program. The report of the Automotive Safety Foundation asks for 500 additional trained engineers to be added to the staff of the Department of Highways. Are you both arguing to the same end—that is, the development of a department staff to handle all design, and to the exclusion of outside engineering help?

Mr. Fritts: Let me say, first off, I have no figures such as Mr. Richardson presented (Ohio Turnpike engineering costs of 9.54 percent for design by consulting engineers, California costs of 24.1 percent with all work done by highway department engineers), nor do I have any quarrel with using consulting engineers. I think that the point we are trying to make is the extent to which we use consultants is largely determined by the circumstances in which you find yourself. In this case, when the

Federal aid came in 1956, the department was already using consultants for a long time to supplement the work of the planning in in the department, and I think that it did a highly commendable job. We have no quarrel with consultants and their fees are equitable, and I cannot speak about comparative figures because I have made no attempt to analyze the content of those costs . . .

Senator Confair: Mr. Fritts, did I hear you say you disagree with the Comptroller General's report as far as outside engineers? Do you agree or disagree with the Campbell Report?

Mr. Fritts: We have no quarrel with employment of them and we do not know the amount of work to be done on the outside. The size of the department may mean 75 percent outside consultation. You need a hard core trained in the same.

Senator Confair: With the extensive study your Foundation has done, you should have some suggestions.

Mr. Fritts: You cannot put it on a hard rule basis. What we have done is check by comparison the status of this particular case with those of the larger states and analyze it.

Senator Wade: Your Foundation represented about 600 companies—the automotive manufacturing people who are interested in motor transportation. How, in connection with Mr. Confair's question, if you were sent into a state that had no highway department at all, how would you do it?

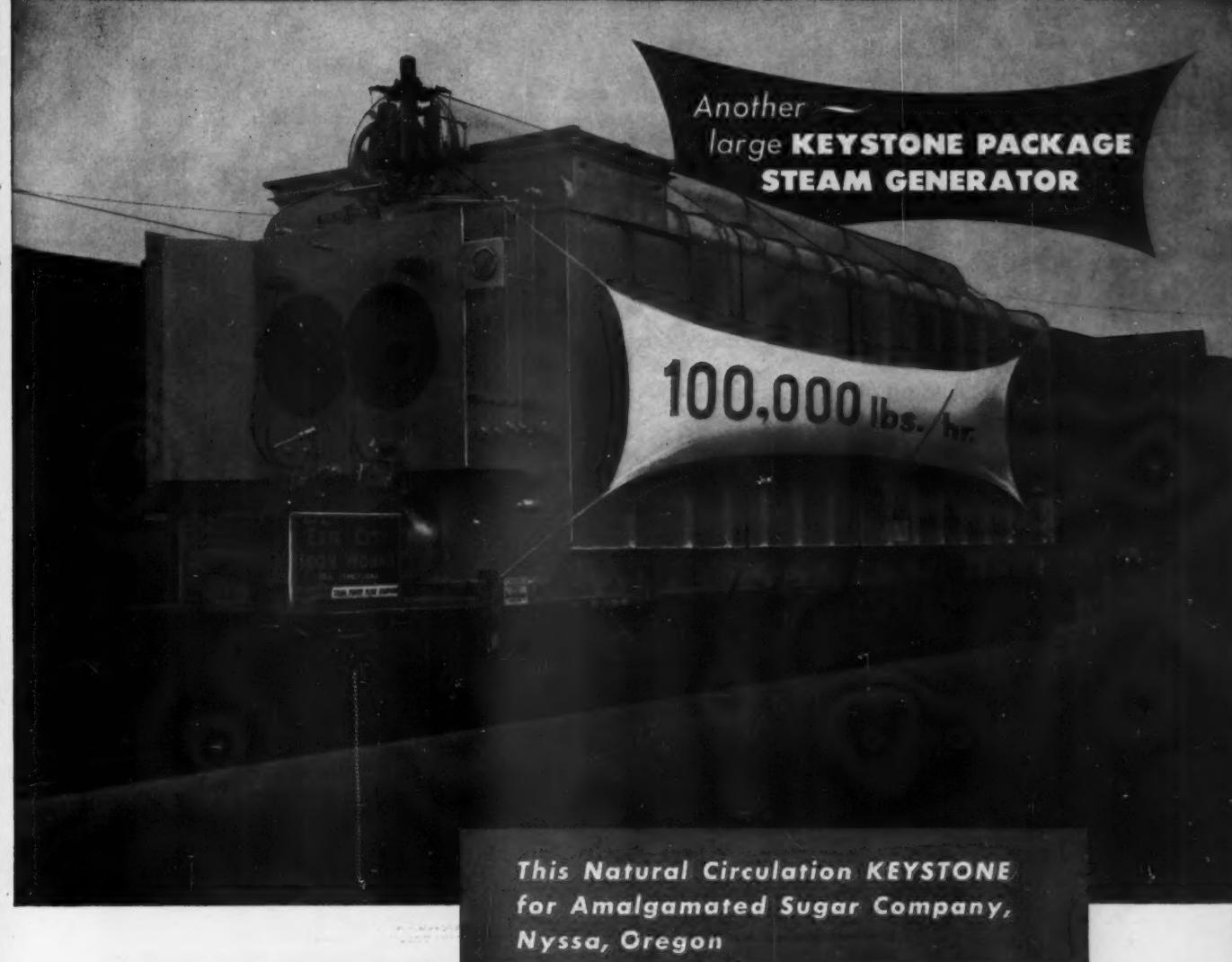
Mr. Fritts: I think that you would have to build from the ground up.

Senator Confair: How do you reach these conclusions?

Mr. Fritts: With comparison with what other states are doing.

Senator Confair: In other words, the procedure we are using in Pennsylvania, insofar as the amount of states you have studied—we are in a normal class?

Mr. Fritts: You are low with some of the states, such as Texas, Cali-



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fornia, Ohio in staff engineers—below the average.

Senator Wade: There are 706 in the department.

Senator Hays: You will not say this is desirable or not?

Mr. Fritts: I will say you are low. You need 500 more. You are the third largest state in terms of miles, people, and motor vehicles. You are about third in the nation but in the terms of your engineers, you are considerably below normal.

Senator Propert: Are you proposing that the Commonwealth do all

the work or just part of the work? Do the states with which you compared Pennsylvania use both private consultants and their state engineers?

Mr. Fritts: Some do both. California is an exception. It does not do any. Ohio farms out a considerable portion and so does New York, but it is somewhere in the range of 40 percent instead of 90 percent which was the amount of design work your state had done on the outside.

Senator Propert: On what do you

base the number of additional engineers required?

Mr. Fritts: If you were going to operate on a basis comparable with those other states.

Senator Propert: That is the answer to my first question. You were estimating the number of engineers in doing all your own work.

Senator Watkins: Mr. Chairman, I would like to ask Mr. Fritts a question. You mention civil service. Do you have any figures to show whether any other state is operating exclusively under civil service?

Mr. Fritts: There is no figure which shows that comparison. They have civil service in a lot of states.

Senator Watkins: You are speaking of engineers. You are not speaking of maintenance employees. I can go for the engineers being under civil service.

Mr. Fritts: We think that all of the people in the department should be competent people.

Senator Watkins: I think we are going too far with civil service. I know one of the best road builders only makes an X for his name. He could not fill out a civil service form but he could make a good road. Your statement on civil service—you just mean engineers?

Mr. Fritts: All technical people.

Senator Watkins: I would say they would be able to fill out a form.

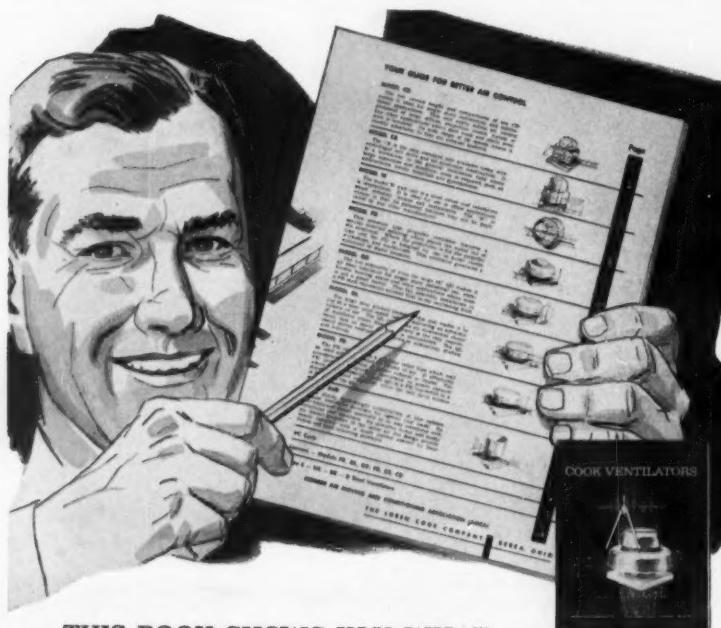
Senator Watkins: Would you suggest we pass a law compelling them to stay in the Department?

Mr. Fritts: No, only that they would know they wouldn't be kicked out by a ...

Senator Van Sant: Even with civil service they would still leave.

Mr. Fritts: Some would leave for the simple reason that you cannot pay as much in public service as we pay outside. But you'll find if your salary bracket is reasonable you could keep them provided they knew they would not be kicked out if they perform. Some people like public service.

Senator Watkins: There is a question in my mind—you say on the



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Ohio Turnpike the cost was 10 percent and in California 24.1 percent and yet private engineering firms paid better money. How can I reconcile that in my thinking?

Senator Wade: How can we poor uninformed legislators . . .

Mr. Fritts: In the case of California and Ohio — on the basis of that evidence, the consulting engineers must at least be more expensive — likely less expensive. What we are saying is that there should be a hard core organization of compe-

tents and particularly in the field of design employing outside help. **Senator Wade:** You said a while ago, you took several states . . . **Mr. Fritts:** We did not compare costs, only the number of personnel in the department.

Senator Propert: Getting back to my original question. You recommend 500 additional engineers.

Mr. Fritts: Let me say . . . once these fundamental steps are taken, Pennsylvania will be in a position

to . . . let me read you [the wording of] our recommendation:

"On the basis of an analysis of the work-load ratios in two other states (Texas and California), it is estimated that the Pennsylvania department needs 500 additional professional engineers to bring its performance up to reasonable efficiency. In those states at present, the ratio of professional engineers to each \$1 million in contracts awarded is 4.6. In Pennsylvania, the ratio is 0.8."

Senator Propert: Now, regarding California and Texas, do I understand those states do not employ outside consultants?

Mr. Fritts: As far as I know, they do not. This is a comparative basis. If you want to go half that far, that is all right with me. You can still do the job by not going near that far.

Senator Propert: If you compared Pennsylvania with California and California does all their engineering, then it is a conclusion—a natural conclusion, that 500 more in Pennsylvania would be able to do all their engineering?

Mr. Fritts: If you have the same number here as in California there would be 500.

Representative Comer: I have one question—in the Foundation report they prepared an organization plan. Is this made up just for Pennsylvania or are there other states that have this same set-up?

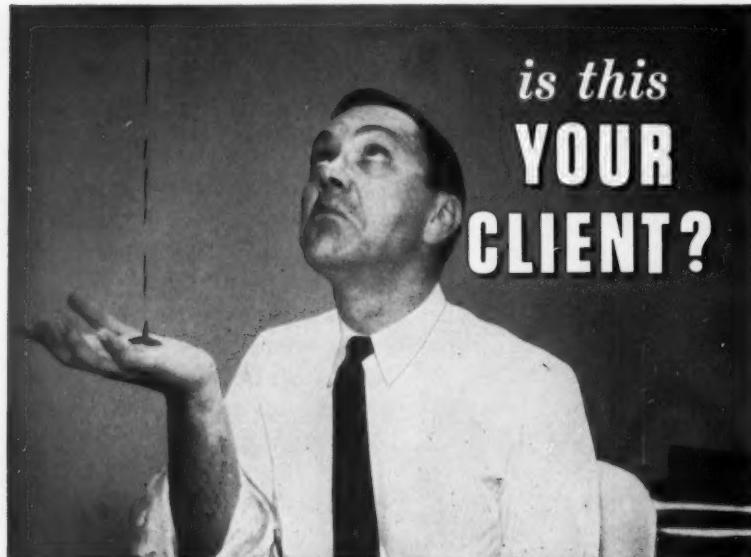
Mr. Fritts: Let me tell you to start with—[no] two of the 48 are alike.

Representative Comer: This is as established for Pennsylvania?

Mr. Fritts: It follows states of comparable size. These things are not sacred. If you want to, modify it. We are interested in seeing that each of the functions is given proper attention. Incidentally, how you do it is not for us to say.

Senator Propert: Would you know how close California comes to this set-up?

Mr. Fritts: One fundamental difference—two deputies instead of



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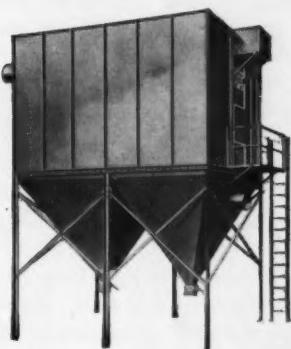
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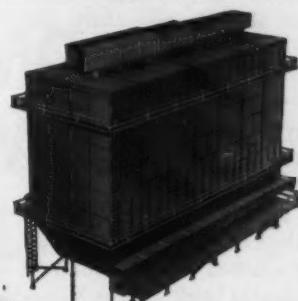


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three as we have recommended. The rest of it is essentially the same, I would say.

•••

Henry D. Harral, Chief Deputy Secretary of the Highway Department, stated ("Field Notes," CONSULTING ENGINEER, February 1959) "Safety Foundation and Pennsylvania Highway Department officials agreed that the present 90:10 ratio of design work was too heavily in favor of the consulting engineer."

"However, he added that the Safety Foundation mentioned California as the example of a state having a good proportion for design work. California, under its constitution, must do all regular highway design with its own forces.

Consulting Engineers' Viewpoint

Presenting the viewpoint of the consulting engineer at the hearing was George Richardson, immediate past president of the American Institute of Consulting Engineers,

and recently elected head of the American Road Builders' Association Engineering Division. In a statement presented to the committee, Richardson said, "A study of any records which have been available to me shows work [by consulting engineers] considerably more economically than large public agency staffs. A Task Force Committee on Real Property Management which made a study of engineering organizations in eight different Federal agencies for the Second Hoover Commission found that the agencies making maximum use of private architect-engineer organizations had the lowest engineering costs."

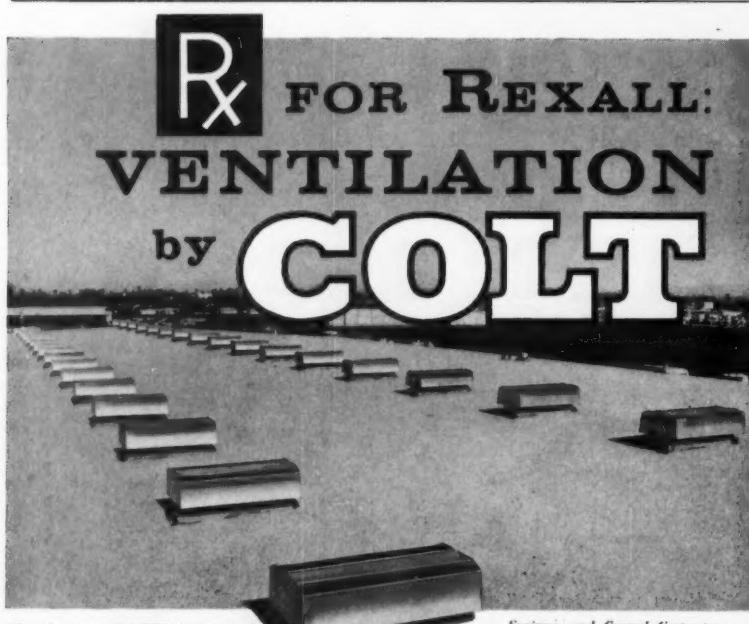
He introduced figures from California showing an average of 24.1 percent for engineering costs, and compared these with the 9.54 percent engineering costs of the Ohio Turnpike, where the work was done by consulting engineers.

"Certain functions can be performed only by highway department staff. We in private practice advocate only that engineering on that portion of the highway program which can be done as well and at lower cost by private firms be allocated to our field of practice," Richardson concluded.

Pennsylvania's Reaction

What was the reaction of Pennsylvania officials to the hearing?

Secretary of Highways Park Martin said, "I do not agree with the Comptroller General that the extensive use of outside consulting engineers substantially and unnecessarily increases engineering costs. His contention that certain steps in the engineering studies should be carried out at state expense is debatable if the work is part of development of the Federal aid program. If it is part of the Federal aid program, it is our contention that it is subject for reimbursement whether carried out by our own forces or by a consulting engineer." □



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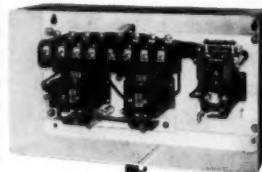
BULLETIN 840



BULLETIN 1209

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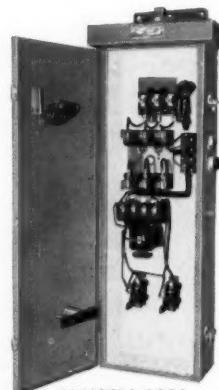
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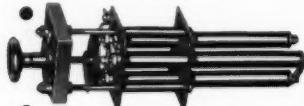
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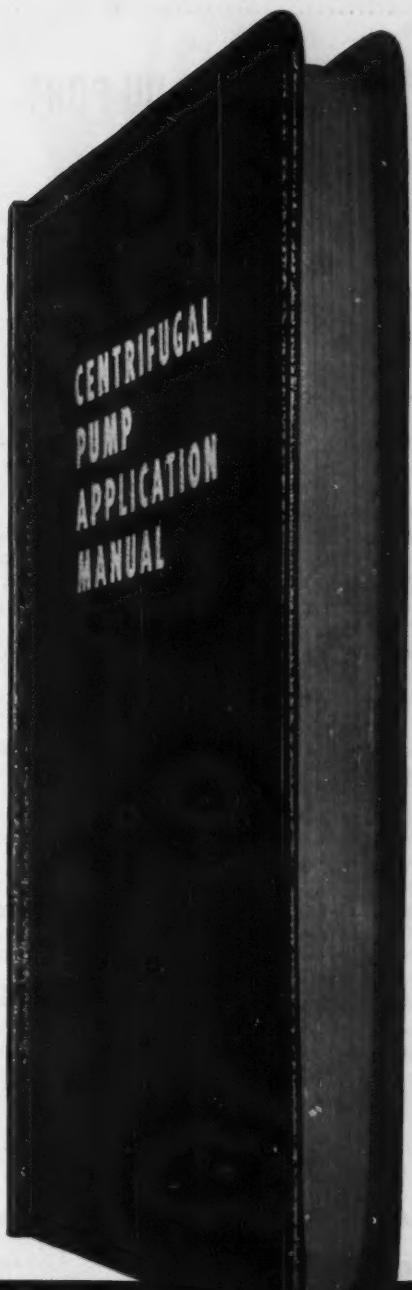
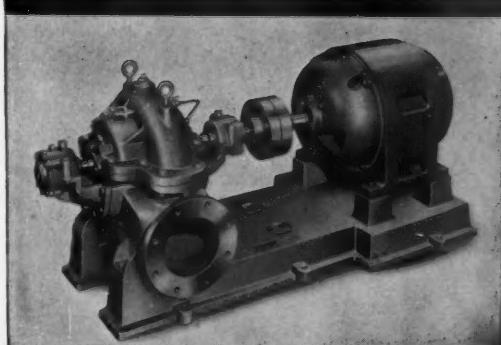
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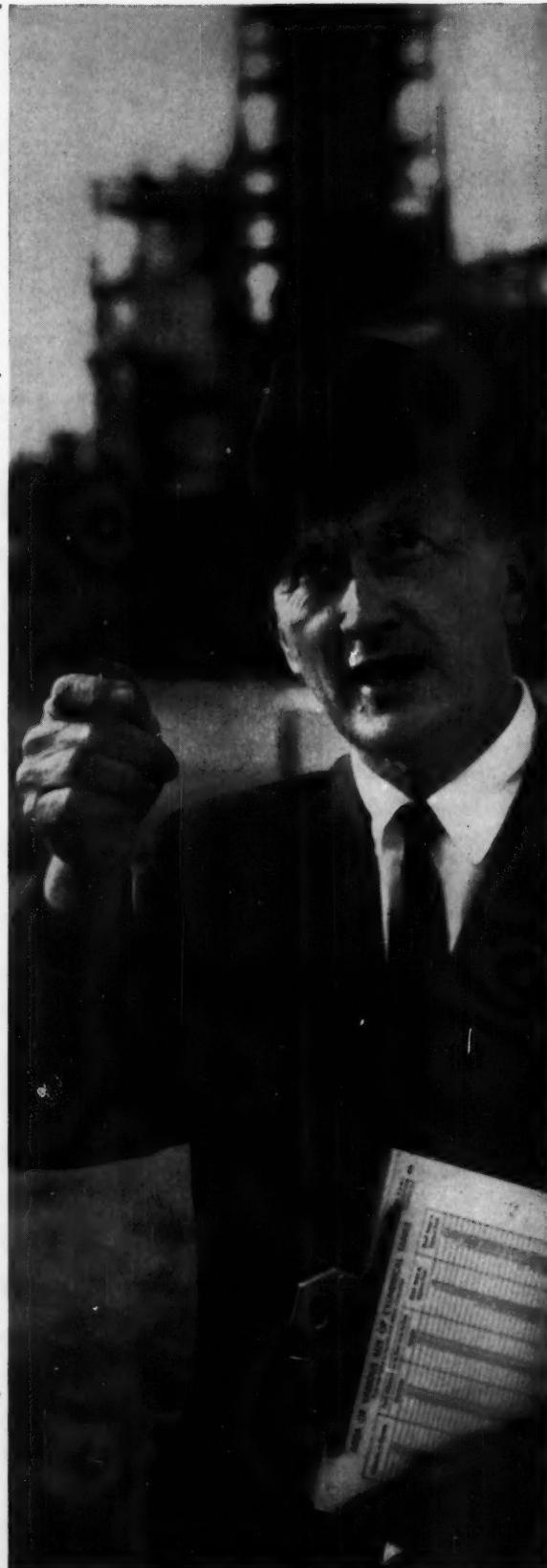
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* * *

L. G. Schmeig began his career in DuPont's Sales Service Laboratory 24 years ago, after completing his education at Temple University. Five years later he became a DuPont Technical Representative servicing company-owned plants. Since then, he's been busy solving painting problems for architects, engineers and maintenance men in the fields of petroleum, marine, utilities and heavy chemicals. In 1958 he took over as Southwestern District Manager, Industrial Maintenance Sales.



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The Word From Washington

EDGAR A. POE

Consulting Engineer Correspondent



PENDING before Congress are proposed expenditures involving an outlay of \$742 million for construction by the Army Engineers for fiscal 1961, starting July 1. The dollar amount is the highest in history. Appropriations will provide for continuation of construction started in previous years on 47 navigation projects, 98 flood control projects, 21 multiple-purpose projects with hydroelectric power facilities, and flood control work on the Mississippi River and its tributaries. Funds totaling \$21 million also are scheduled to be provided for 31 new starts.

The Bureau of Reclamation will spend \$226 million in 1961 to continue construction and rehabilitation work on 64 projects for irrigation, water supply, flood control, and hydroelectric power. Included are units of the Missouri Basin project and the Colorado River storage project.

The Tennessee Valley Authority will spend an estimated \$179 million, the major part being for power facilities.

The largest single public works program will be the highway construction program. Approximately 9000 projects costing \$4.1 billion are expected to be approved next year. Cost of the Federal share will be \$2.9 billion.

The Federal Aviation Agency, which administers grants for public airport construction, has drafted plans for initiating projects at 325 airports. The program also will provide air navigation and traffic management facilities as well as instru-

ment landing and lighting systems involving an additional outlay of \$130 million.

Construction of college dormitories will total \$89 million in the coming fiscal year. Construction also is expected to begin on 30,000 public housing units. Loans to small communities for public facilities will require Federal expenditure of \$24.5 million, according to the estimates before Congress.

A new veterans hospital at Cleveland, and one in the Nation's Capitol will be started. This will bring the total number of VA hospitals since World War II to 77 with new beds totaling 38,240.

General Services Administration will initiate construction on 16 new Federal buildings which will cost \$154 million. Planning will be started on additional buildings for future construction. A program for air conditioning of existing buildings will be continued. GSA also has plans for a new fallout shelter program at certain Federal relocation sites and in some existing Federal buildings.

Next year the National Bureau of Standards will begin construction of its new facilities at Gaithersburg, Maryland, as a replacement for the existing facilities located in Washington.

Atomic Energy Commission construction expenditures will be principally for continuation of work previously authorized. It includes a new production reactor, power reactors under the cooperative demonstration program, an experimental gas-cooled reactor, and

a land-based prototype reactor designed for use in destroyers.

A military construction authorization bill, totaling over \$1 billion, is before Congress, and another Defense Department bill requests authorization from Congress to build 9786 units of family housing for military personnel and their dependents at bases in this country and overseas.

The Senate passed a bill to provide a two-year program of Federal grants, to be matched by the states, for school construction or teachers' salaries or both. The bill, loaded with presidential-year politics, is a bad bill although it appears innocuous. It authorizes appropriations of \$917 million for each of two years. President Eisenhower may veto the measure should it get passed by the House. With four Democratic Senators running for the presidential nomination, the Senate got the politically attractive bill passed in a hurry. However, it appears destined to languish in the House for a considerable time.

The Agriculture Department provides assistance to state and local groups to further conservation, development, utilization, and disposal of water in upstream watersheds. The 1961 budget proposes \$5 million to inaugurate construction on new watershed projects, with an estimated total cost of \$29 million.

The Housing and Home Finance Agency will have worked with local authorities in completing 61 urban renewal projects by the end of 1961, but 510 additional projects

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will be under way. Under the Post Office commercial leasing program an estimated 1400 buildings costing \$67 million will be built in 1961 by private interests for long-term occupancy by the postal branch of the Federal government.

A summary of Federal electric power activities shows that public power continues to expand. Federal agencies at the end of the 1959 calendar year were operating generating capacity amounting to about 15 percent of the total capacity of major electric utility systems in the United States.

Additional capacity of 2 million kilowatts scheduled for completion during the calendar years of 1960 and 1961 will increase the Federal installation to 24.2 million kilowatts. This capacity and the other capacity under construction will bring the total to an impressive 31.7 million kilowatts.

Besides all of this, the REA through 1959 had financed loans for the construction of 2.3 million kilowatts.

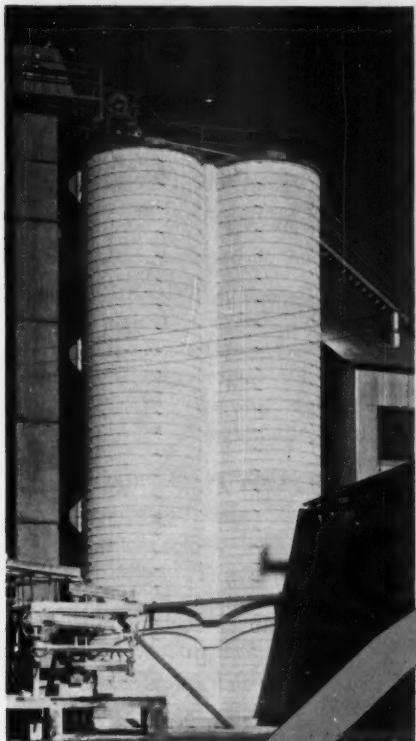
A total of 1084 miles of additional transmission facilities for marketing Federally produced power are scheduled in 1961. This will increase the Federal transmission system total to 30,283 miles.

Garrison Diversion Plan

A detailed report proposing the development of a 250,000-acre Garrison diversion irrigation development in North Dakota as a unit of the Missouri River Basin project is before Congress. The proposed project, submitted by Secretary of the Interior Fred A. Seaton, would involve construction of the principal supply works and the water-use works.

Most of the land that would be irrigated is now dry farmed with wheat the principal crop. The economic investment is estimated by engineers to approximate \$200 million which would include a share of the costs of Garrison dam and reservoir, already built by the Army Engineers, and of the Mis-

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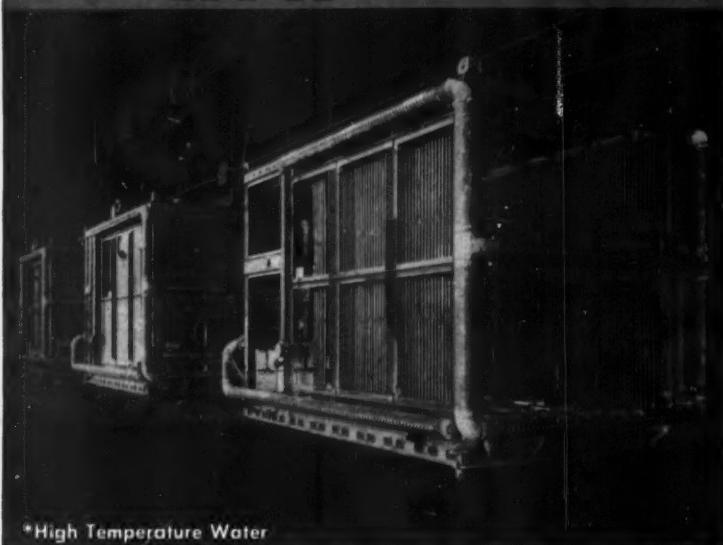
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souri River Basin project for the production of public power.

The Bureau of the Budget, which is directly under the White House, refused to recommend favorable action on the project. However, the Bureau said it had no objections to submission of the report to Congress for study and consideration. Tied up in the vast over-all project are plans for municipal and industrial water works and power allocations.

Garrison diversion would be comparable in size with the Columbia Basin, Central Valley in California, and the Lower Colorado River projects.

Bureau of Reclamation

The Bureau of Reclamation is seeking authority from Congress for \$5 million to purchase foreign currencies for engineering research in foreign countries to supplement domestic research.

Labor Department Survey

A special manpower survey by the Labor Department forecasts the nation's working population will be 87 million persons by 1970 as compared with 73 million today. The gross national product (goods and services) will increase to more than \$731 billion during the decade. During the same 10-year period, the survey says, the United States population will rise to 208 million, a 15 percent increase.

Hoover Dam Power

The great Hoover Dam, selected by the American Society of Civil Engineers in 1955 as one of the country's seven modern engineering wonders, is 25 years old this year. The dam, which corralled the Colorado River for the first time, is now backing up the river 115 miles into the lower reaches of the spectacular Grand Canyon and has a 550-mile shoreline. The Bureau of Reclamation says the 158,000-acre reservoir today contains about 19 million acre-feet of water, equivalent to putting South Carolina un-

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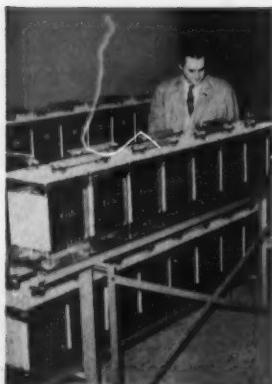
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der a foot of water. Yet it is only filled to two thirds of its capacity.

The last of the great turbines and generators is now being installed to bring the hydropower plant to its full capacity of 1,344,800 kilowatts. The last turbine will not increase the total annual energy output of the power plant which has utilized all of the water flowing down the river since 1936. However, engineers for the Bureau of Reclamation assert that it will enable Nevada, for which the added generator is being installed, and other customers to better utilize their share of project power.

Airline "Road Markers"

A study of automatic computation methods for determining the best possible operating frequencies for radio transmitters used as "road markers" on airlines is being made by the Bureau of Standards. The Federal Aviation Agency requested the study.

A network of such transmitters are marking routes between U.S. cities. They transmit signals to aid pilots in flying a straight line course. Expansion of commercial and military air operations at a rapid rate makes it necessary to add a substantial number of new transmitters to the existing network. Locations of these transmitters are determined by technical and economic considerations.

Difficulties of frequency selection grow out of the fact that transmitters with identical or neighboring carrier frequencies must be spaced wide enough to prevent signal interference. Furthermore, this must be accomplished within the range of 100 discrete frequencies assigned to FAA. Assigning a frequency to a new transmitter without encountering interference results in long and laborious examination of many old transmitters, according to the Bureau.

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in engineering, mathematics, and science will be awarded in 1961 by the National Science Foundation. Included in this total are 1150 fellowships for summer study to secondary school teachers and college teaching assistants, and 1000 cooperative graduate fellowships to be awarded through participating colleges and universities.

Government Educates Engineers

The Atomic Energy Commission operates schools and conducts courses in nuclear science and engineering, reactor operation and hazards, and the use of radioisotopes for graduate and undergraduate students and for industrial personnel and medical workers.

Although not directed toward increasing the supply of engineers and scientists, a number of Federal activities nevertheless materially assist in this field. These include such programs as the training of veterans; the Reserve Officers Training Corps; the in-service training of government, civilian, and military personnel; and fellowships awarded under the National Defense Act of 1958.

Engineering Enrollment Down

Total number of freshmen in the nation's engineering schools the first semester of the 1959-60 academic year was 68,000, a 3 percent decline from the 70,000 enrolled in 1958. U. S. Education Commissioner Lawrence G. Derthick said the number of full-time and part-time engineering undergraduates was 243,000 compared with 257,000 in the fall of 1958. On the other hand, general college enrollment rose from 3,259,000 to 3,402,000. This 4 percent rise highlights the decline in engineering.

Concrete or Asphalt?

A bill has been introduced in Congress, by Rep. Moulder of Missouri, which would require that all plans and specifications for Federal-Aid highways be prepared with alternates for concrete or asphalt. The

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Job Location . . . Zanesville Interceptor Sewer
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Engineer . . . Floyd G. Browne &
Associates, Marion, Ohio
Contractor . . . Roger Au & Sons
Mansfield, Ohio
Materials . . . 15,000 Ft. V.C. Pipe, A.S.T.M.
C-13 with Presto-SEAL joints,
6" to 24" diameter inclusive.

TEST DATA

Date of Test . . . June 18, 1959
Size of Line . . . 24" V.C. Pipe
Length of Line . . . 250 Ft.
Type of Test . . . Extrusion
Allowable Loss . . . 500 Gal/in/Mi/day

RESULTS

After line was filled only 90 min., loss was
approx. 1/3 the allowable.

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bill also would require the award of contracts to the lowest bidder.

Report on the Seaway

Traffic on the International Rapids section from Montreal to Lake Ontario carried only 20 million tons instead of an anticipated 25 million. A late thaw last spring, the steel strike, a decline in the sale of Canadian grain, and the slow down of American exports all joined forces to limit the total tonnage. However, the reduced figure is still 70 percent above the 1958 figure when the old canal, which was not deep enough for ocean going ships, was still used.

To meet this new competition, railroads are planning a seasonal shipping rate, high when the seaway is frozen up, low when it is going full blast in the summer. Baltimore and Philadelphia were hurt most by the seaway traffic, both losing some bulk traffic in 1959. Inland, Buffalo has suffered because it no longer gets transhipment business, because deep draught vessels can now travel directly between the Lakes and foreign ports.

Meanwhile, development of facilities of Great Lakes ports, deepening of the channels in the Upper Lakes, and ultimately providing duplicates for all eight locks on the Welland Canal are the best assurance of future growth of the Seaway.

Partnership Taxes

According to a recent ruling of the tax court, a partnership between a professional and a nonprofessional is acceptable. The specific case dealt with a partnership formed between a doctor and his wife. The taxpayers set up the partnership with a fiscal year beginning April 1, 1953, and ending the following March. Under the law, the earnings of partners are taxable only to them as individuals, and only for the year in which a partnership's fiscal year ends. The case gained attention when the individu-

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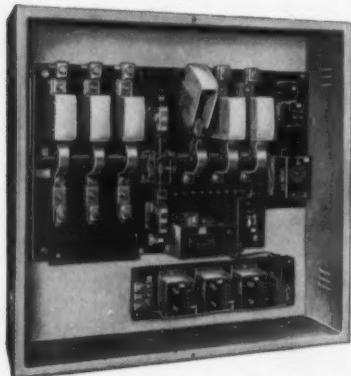
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State _____

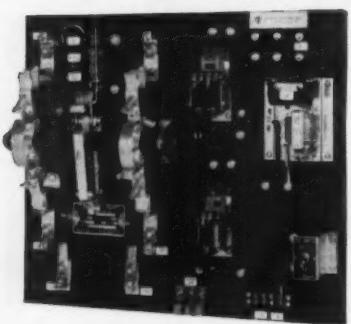
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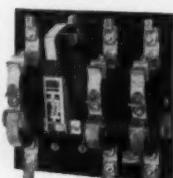
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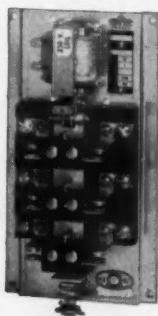
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als had filed under the calendar year rather than under the fiscal year as the Court had ruled. However, the Internal Revenue Service, under a provision of the 1954 code, now must give its consent before taxpayers adopt a fiscal year for a partnership that differs from the taxable year of each of the principal partners.

New ICA Forms

A consulting engineer who has not filled out a set of the new International Cooperation Administration experience data forms will not be considered for ICA projects. Carl H. Giroux, consultant to the Office of Industrial Resources, explained that information from the experience forms is transferred onto punch cards. These cards are used for the initial screening in selecting a consulting engineer. After the key sort cards narrow the selection, ICA officials then refer to company brochures.

Sewage Grants Limited?

There were predictions on Capitol Hill that President Eisenhower will veto any measure raising the annual grants to any locality to help build sewage disposal plants. The White House wants to hold the grants to \$20 million a year. Yet a House-passed measure, which would raise the present limit on annual grants from \$50 million to \$90 million, was sent to the Senate without a single dissent.

\$1.7 Billion Bridge Lift

The House Public Works Committee is not pleased that it took the Defense Department more than 2½ years to determine that it needs a 16-ft overhead clearance for bridges on the projected 41,000-mile Interstate Highway System instead of 14-ft clearances. Representative John A. Blatnik, Democrat of Minnesota, and chairman of the Interstate System, estimates that it will cost an additional \$1.7 billion to raise existing and future bridges to the 16-ft height.

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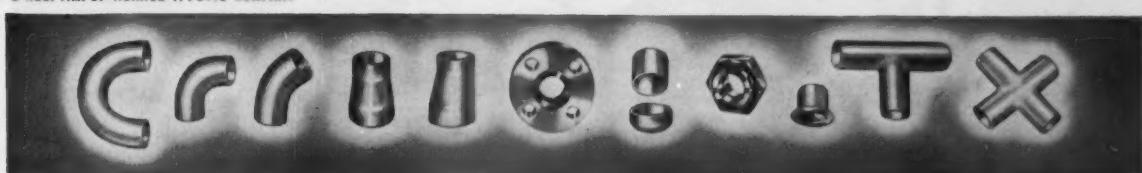
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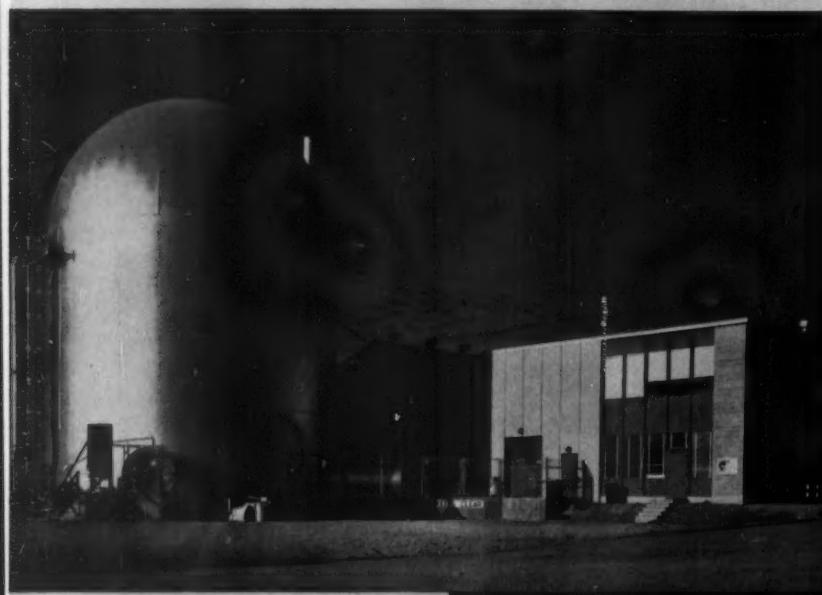
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here is used in the power plant. It meets the rigid standards required in regulating ventilation supplying personnel with safe, comfortable, uncontaminated air.

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Plainfield, N. J.

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Mech. Engineer:
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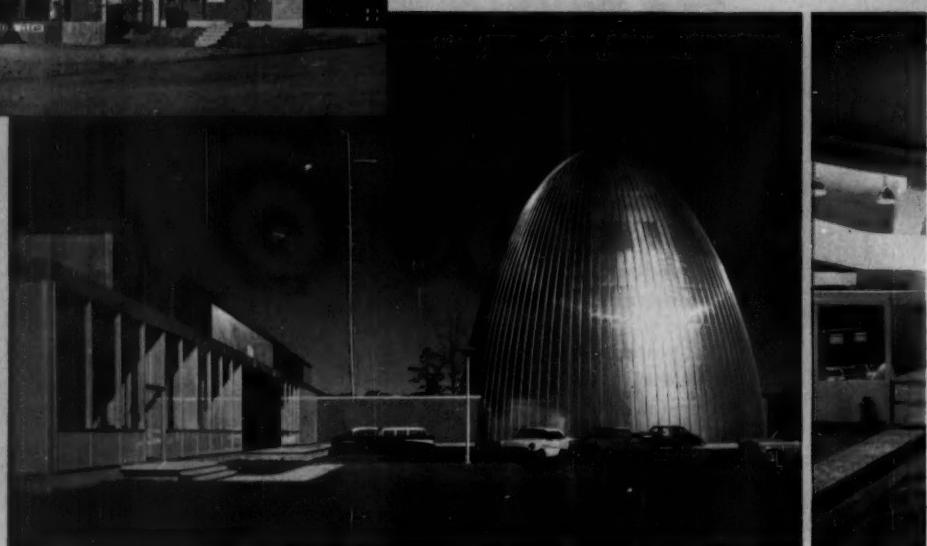
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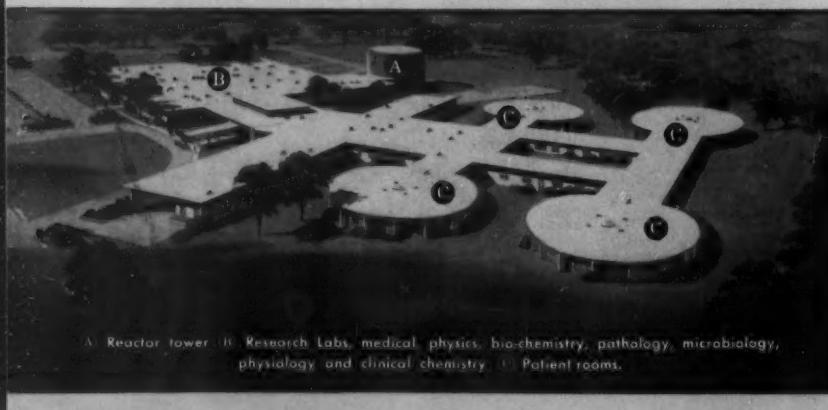
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Upton, N. Y. — Nuclear research here will benefit all mankind. The first nuclear reactor (1000 kw) designed specifically and exclusively for medical research and treatment is located in the reactor tower A shown below.

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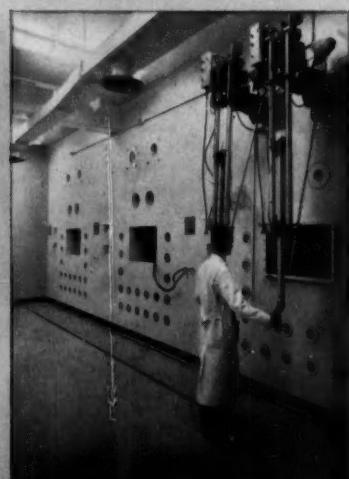
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in these completely air conditioned buildings regulates temperature, humidity and ventilation.



Owner-members of Industrial Reactor Laboratories: American Machine & Fdry. Co., American Tobacco Co., Atlas Powder Co., Continental Can Co., Corning Glass Works, National Distillers & Chem. Corp., National Lead Co., Radio Corp. of America, Socony Mobil Oil Co., U. S. Rubber Co.

Below: Operators at Industrial Reactor Laboratories, protected by 3 ft. thick viewing windows, conduct experiments with master-slave manipulators shown below.



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At the Birth of the Atomic Age in 1942 at the University of Chicago, temperature of the space occupied by "the first nuclear reactor" was controlled by Powers Type K Thermostats installed under the West Stands of Stagg Field.

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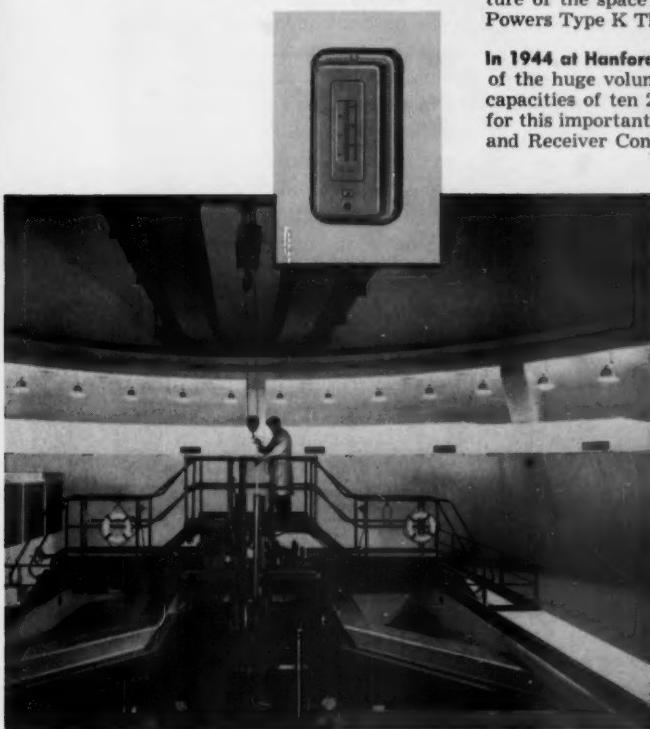
Accurate Control of Air Conditioning is Vital in modern nuclear reactor plants. Safety and comfort of employees and reliability of ventilation controls are specially important in radioactive "hot" areas. In the three prominent installations on the opposite page, Powers control is required to meet rigid standards of performance.

Other Users of Powers Controls: Some AEC buildings in Oak Ridge, Tenn.; at Argonne National Laboratory, air conditioning and cooling water for a Cyclotron is regulated by Powers; in AEC plants at Portsmouth and Fernald, Ohio and Weldon Spring, Mo.; in Atomic Energy of Canada Ltd., buildings 145 and 465 at Chalk River, Ont., Powers controls heating and air conditioning.

Nuclear Reactor Research Facility of the U. S. Naval Research Laboratory, Wash., D.C. is air conditioned and Powers controlled.

At Illinois Institute of Technology, Chicago, the first nuclear reactor for private industrial research was installed by the Armour Research Foundation. Powers air conditioning control is installed here in the Physics and Electrical Engineering Research building in which the reactor is located.

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Inside the dome at IRL a crane services reactor pool. Powers control here, regulates the ventilation and air conditioning. Note ducts on circular wall.

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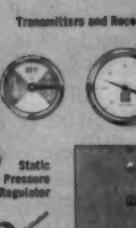
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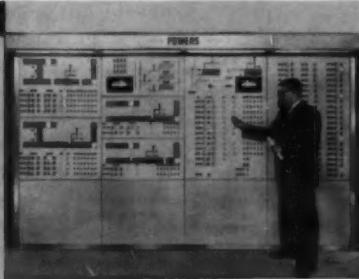
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Powers Graph-O-Matic Control Centers are also available in Console models. All types are custom built to meet the requirements of any comfort or process control system.

Dear Mr. Comptroller General,

Cordially yours,
Ralph Westcott

IT WAS BACK ON November 16 that Ralph Westcott, president of the Consulting Engineers Council, called on Mr. Joseph Campbell, Comptroller General of the United States, and discussed with him a report published by the General Accounting Office in which it had been stated that cost-plus-percentage contracts "create an incentive for consultants to carelessly or deliberately increase direct cost, thereby proportionately increasing reimbursements for overhead, contingencies, and fees." After the meeting Westcott reported that the Comptroller General had been sympathetic and had discussed "the possibility of CEC reviewing subsequent reports . . . prior to publication." Westcott also reported that "a slightly different tone, insofar as consultants are concerned, is anticipated in GAO reports released in the future."

There is, however, many a slip between anticipation and accomplishment when dealing with Washington officials.

Here follows a letter to Mr. Campbell dated December 29, 1959, and recently released by Consulting Engineers Council.

Dear Mr. Campbell:

Another report of the General Accounting Office dated December 1959 has come to my attention regarding the Bureau of Public Roads and the Federal Aid to Highway Program in Region 2. You may recall what I considered to be a very cordial and candid discussion I had

with you on November 16 concerning the role of consulting engineers in the highway program.

At that time, it was my understanding that the criticisms we raised concerning the previous report would not likely be repeated in the same tenor that the earlier report followed. It was my further understanding that we would have the opportunity to comment on reports of this type, prior to publication. This later report certainly makes what we consider to be a number of very unfair accusations. Quoting from the report, 'The use of consulting engineers results in additional costs to the states and the Federal government by reason of the overhead and profit included in the fees normally charged by such firms.' We believe that this statement is wholly unwarranted and without validity; however, your office could obtain the actual proof for objective cost comparison, none of which we have seen, nor has it been published.

Quoting again from this latest report issued by your office, 'It is our view that the extensive use by some states of outside consulting engineers for the usual types of engineering work, which in other states is done by state-employed engineers, substantially and unnecessarily increases engineering costs and results in an avoidable inequity among the states in Federal participation in these costs.'

We question the motives of these statements. It appears they are di-

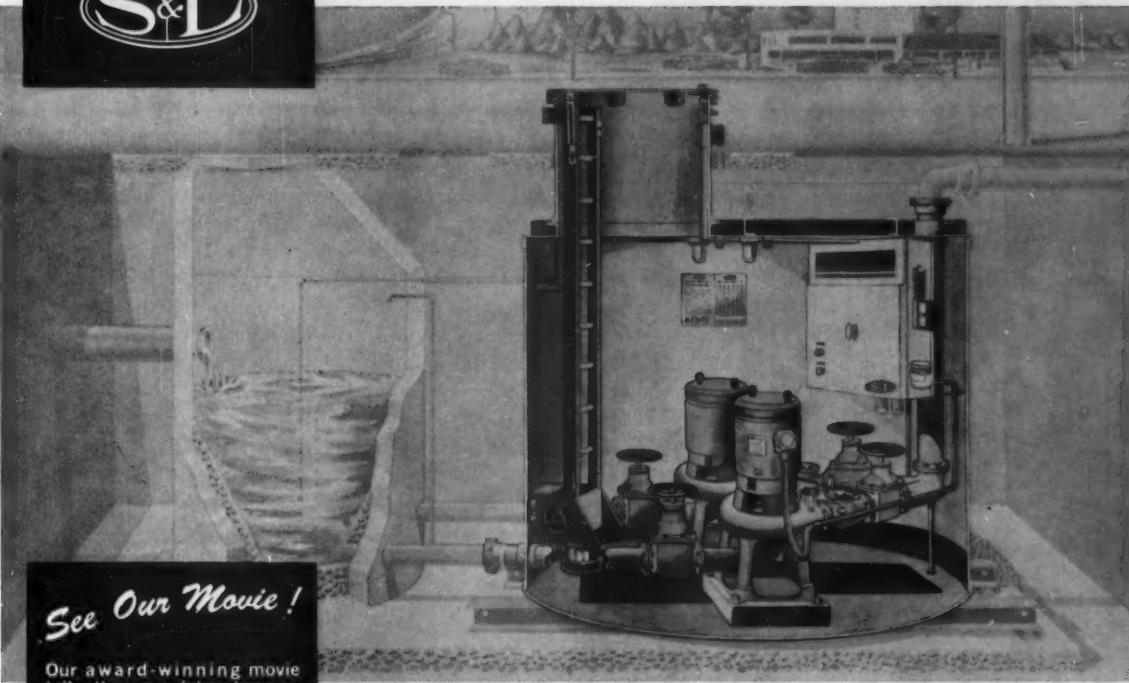
rected solely at the elimination of consulting engineers from the highway program. We would like to point out that consulting engineers are available for specific projects with no continuing costs to the government after completion of the project. When a Federal or state agency has a lull in work load, Civil Service employees are kept on, thus increasing the overhead of that department; however, to the best of our knowledge, these costs and the costs of the housing facilities for the department, plus the fact that these are tax free facilities, which our offices are not, are never evaluated when discussing the cost of government agencies doing their own engineering. The tendency is to utilize as the basis for costs only the direct labor chargeable to a specific project with a nominal overhead. It is axiomatic that the competition in private enterprise demands efficient operation and maintaining staffs only capable of handling the current work load, all of which is contrary to the practices of Civil Service and government operations.

Quoting from Bulletin No. 60-2, issued by the Director of the Bureau of the Budget, Mr. Maurice H. Stans, at the direction of the President, "2. Policy. It is the general policy of the administration that the Federal government will not start or carry on any commercial-industrial activity to provide a service or product for its own use if such product or service can be procured from private enterprise through ordinary . . . channels. "B. Costs. Continuation of government operation on the ground that procurement through commercial sources would involve higher costs may be justified only if the costs are analyzed on a comparable basis and the differences are found to be substantial and disproportionately large. In such cases, the costs of both government operation and private procurement must be fairly computed and complete. The costs assigned to government op-

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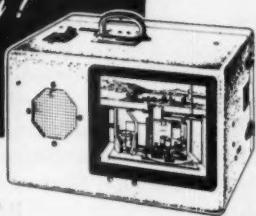


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eration must cover all direct and indirect outlays, such as pay and other allowances for personal services and leave; contributions for retirement and disability; supplies; materials; transportation; warehousing; utilities; maintenance; repairs; and similar factors. Appraisal of elements not usually chargeable to current appropriations, such as depreciation, interest on the Government's investment 2/ the cost of self-insurance (even though it is unfunded)."

The particular issue that we want to make is that neither Federal government agencies, nor state highway departments make available to the taxpayers and the public the actual costs of their operations. When we talk about costs, certainly all of the elements of cost included in Paragraph B above quoted from the Bureau of Budget should be evaluated. Government agencies have overhead and administrative costs, which are all too often hidden in the general tax structure. Profit for consulting engineering firms is nominal and from this must also be paid state and Federal income taxes to support these government enterprises.

It appears evident to me that I completely misunderstood you at the time of our interview, or you have not read this report in the light of that discussion. We believe that it is high time that the General Accounting Office undertake true cost analyses of the operations of government agencies and departments, who are in direct competition with the professional services offered by engineers in private practice. The fees paid to us are a matter of public record and we believe that they are fair and equitable, and that the services rendered are professionally competent and economical. It is unfair for these critical statements to be continually made that consulting engineers' services are excessive when no evidence of government costs are published to prove or disprove these statements.

The implications throughout this report dealing with the services of consulting engineers are that there is something immoral, dishonest, or detrimental to the government's best interests when private practice consulting engineers are utilized by state highway departments. We do not believe these implications to be true. When and if verifiable audited statements are published showing all of the costs of any Federal or state engineering departments truly reflecting the full costs of that operation, we will abide by these findings. Until that time, we have every right to contest unsupported statements, such as those made in this latest report. In California, a legislative investigating committee has determined that the costs of the California state highway department are in excess of 25% of the cost of construction. While the state highway department performs services not regularly or appropriately delegated to consulting engineers, this is a far cry from the average of 4% awarded consulting engineers based on cost of construction, which was contained in your previous report, and assuming for the sake of argument that the consultants made 10% on this 4%, it would then amount to four-tenths of one percent on the total cost of construction for profit, from which must be paid income taxes to support your agency and the others of the government.

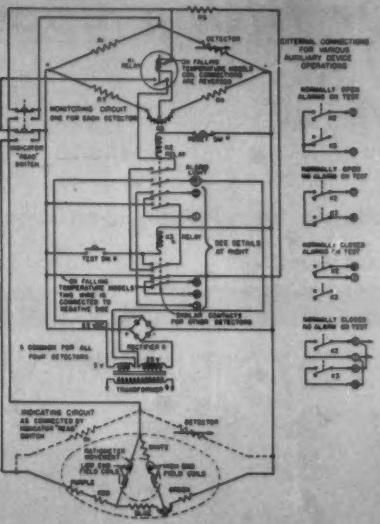
It was my feeling when I discussed this problem with you that the General Accounting Office had no reason to impugn the contractual relations entered into with consulting engineers, but this last report belies that belief.

Copies of this letter will be withheld from distribution to other interested groups and government officials, pending an early reply from you. Distribution is scheduled for January 11, 1960.

Ralph M. Westcott
President
Consulting Engineers Council

Questions and Answers on the EDISON OMNIGUARD SYSTEM

The Most Effective Means of Measuring and Safeguarding Temperatures and Pressures



Q. How does the Omnidguard System work?

- A. Edison's Omnidguard is characteristically simple and unique in its operation. Each Omnidguard channel is a conventional D-C Wheatstone bridge circuit in which an Edison temperature or pressure detector forms the variable leg of the bridge. As the temperature or pressure rises and falls, the detector resistance increases or decreases. An Edison relay (K1) across the bridge senses the current flowing through it. When conditions are normal the current flows in the direction to hold the relay contacts open. When a variation occurs, however, current flow reverses and the contacts of this alarm relay close. Relay K1 energizes the coil of auxiliary relay K2 which actuates an alarm light on the panel face to show which detector is "off-normal," actuates an external alarm or annunciator and maintains the alarm indefinitely — until conditions have returned to normal and the normally closed reset switch is opened.
- Any temperature or pressure can be read at any time by pressing the indicator read switch for that point.

Q. Is Omnidguard dependable?

- A. Reliability is built in. Since each measuring channel is an independent, separate circuit, complete system failure is unlikely. Only the most reliable components are used. Edison resistance temperature detectors don't "drift" over years of service. There are no scanning mechanisms to wear out...no delicate components...no electronic circuits...no amplifiers...no periodic maintenance requirements.

Q. Is Omnidguard flexible?

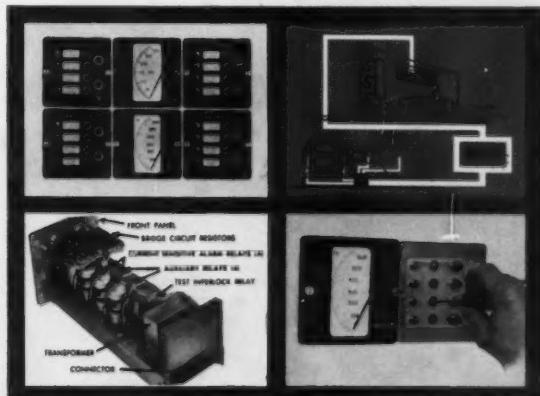
- A. Completely. A system can monitor as few as 4 or as many as hundreds of variables. Buy only what you need. Since channels are independent of one another, each can be set to alarm at a different temperature or pressure. Alarm settings can be changed easily and quickly. Omnidguard can be used for alarm or shut down of equipment, alarm can be local and remote, is easy to telemeter to remote control station.

Q. Is installation economical?

- A. Omnidguard is the simplest system available. Fewer parts mean lower costs, less maintenance. Plug-in monitors are installed in minutes with no special tools or calibration. Ordinary copper wire connects remote detectors to monitors. Monitor units act as their own annunciators, identify each temperature and pressure, eliminating the need for extra equipment in most installations. Omnidguard is a *complete* system with all parts including hardware supplied by Edison.

Q. How accurate are Edison's Resistance Temperature Detectors?

- A. In the range from -200°F to +1350°F, no other type of detector is as stable, sensitive, and accurate over years of service. Response times of 0.8 seconds are common — detectors are repeatable to .05% over years of use, resistance being directly proportional to temperature. Resistance Pressure Detectors are accurate to 1% or better depending on pressure range.



For complete information on the Edison Omnidguard System, industry's simplest, most reliable means of continuously monitoring critical temperatures and pressures, write for Bulletin 3036C.

Thomas A. Edison Industries

INSTRUMENT DIVISION

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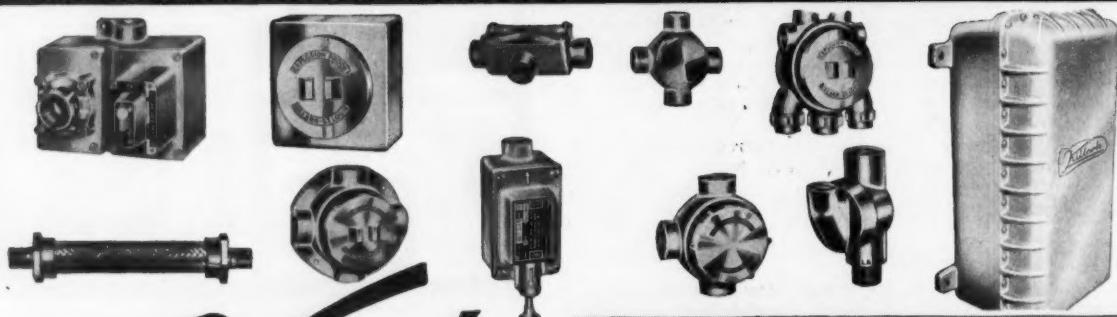
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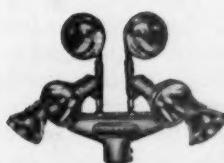
Vapor-Proof



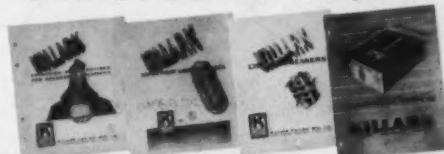
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Lee's Lecture

Industrial Research Facilities

JOHN F. LEE

Broughton Professor and Head
Department of Mechanical Engineering
North Carolina State College

SINCE WORLD WAR II, American industry has become fully aware of the need for new ideas and techniques developed through research. As a result, tremendous sums of money have been spent on the construction of new, and the expansion of old, industrial research facilities. An increasing number of industrial firms are learning that their survival depends on meeting the stiff competition offered by research minded competitors.

With this new emphasis on research, there is a growing awareness that it cannot be done effectively in the plant environment, where pressing day-to-day problems and the predilections to perfect present techniques blinds the researcher to the long-range vision needed for corporate good health. Hence, there is a growing tendency to locate industrial research centers away from the production plants in a freer climate suggestive of the university campus.

The result is a closer kinship between the industrial researcher and his counterpart on the university campus. The term "academic research" has fallen into disuse, for it has very little meaning in an era when today's academic

problem very well may be tomorrow's corporate problem.

This closeness of academic and industrial researchers is manifested by the similarity in the amenities demanded by them in the environments in which they work. Cultural, recreational, and educational opportunities in the vicinity of the industrial research center loom as important factors in the building up and retention of a competent research staff. For this reason, a prime consideration in determining the location for an industrial research center is close proximity to a first-rank university, or better, a cluster of top-grade universities.

There are several obvious advantages in locating industrial research laboratories near universities. First, there is the kinship between industrial and academic researchers which permits a free flow of ideas to the advantage of both groups. Because of this close kinship the old bugaboo of "the town" and "the gown" has largely disappeared from the American scene. Second, there is the advantage of a reservoir of specialists on the university faculties available for consultation on special problems. Third, the sharing with industrial

neighbors of such university resources as nuclear reactors, accelerators, and other expensive research equipment, often hard to justify as a capital investment by industry, is common. Fourth, there is the opportunity for both formal and informal advanced education afforded to the staff members of industrial research groups in the vicinity of a university.

Locate Near Universities

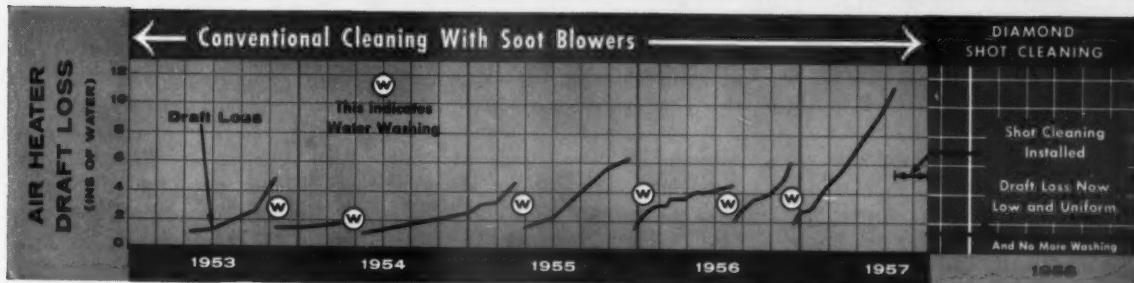
One has only to look at the mushrooming complex of industrial research laboratories around Stanford University, Princeton University, and the Boston-Cambridge area for convincing evidence of this phenomenon. One of the most striking examples is the Research Triangle of North Carolina. In this small triangle — formed by North Carolina State College, Duke University, and the University of North Carolina — is an area which is practically made to order for the industrial research laboratory. Its development, in less than three years, has amazed even its most enthusiastic promoters.

An examination of the reasons why several industries chose the Research Triangle of North Caro-

DIAMOND SHOT CLEANING

Keeps TUBULAR AIR HEATERS CLEAN

that Could Not be CLEANED BEFORE



Here is an example of how Diamond Shot Cleaning solves certain cleaning problems previously impossible of solution.

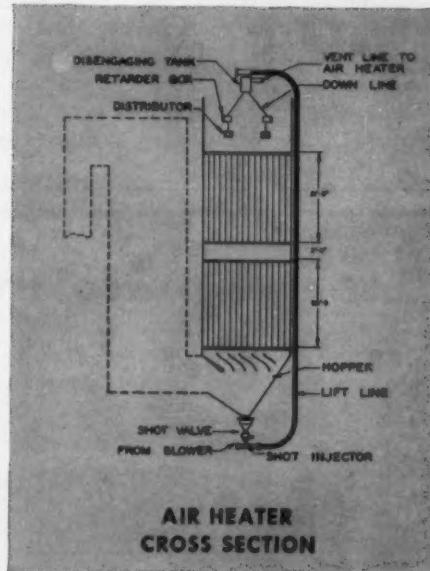
The chart shows increase in draft loss across a tubular air heater resulting from ineffective soot blower cleaning. Mounting draft loss caused decrease in fan capacity and reduction in load. During the first four years of operation it was necessary to water wash this air heater six times (at "W"). Each washing required a three day outage of the boiler.

Diamond Shot Cleaning was installed in September 1957. Since then draft loss has been minimum and uniform. Water washing with consequent boiler outage has been eliminated entirely.

This first installation was so successful that a second air heater was equipped with shot cleaning in 1958.

Diamond Shot Cleaning uses falling shot to clean horizontal tube surfaces such as superheaters, reheaters and economizers, as well as tubular air heaters. The shot is cascaded over the horizontal tubes or through vertical air heater tubes by distributors and scours the surfaces as it falls. Deposits are removed in small particles most of which are carried away by the gas stream. Heavier particles fall into the hopper and recirculate with the shot until broken fine enough to be picked up by the gases. Cleaning is thorough even with difficult fouling such as is found in black liquor fired boilers. Areas which tend to foul rapidly can be kept completely clean by increasing the automatic shot cycle (it may be continuous if necessary) without disturbing boiler operation.

In line with our half century policy of providing the best in boiler cleaning, Diamond has conducted extensive research on shot cleaning over a period of years. More than 30 installations are now in successful operation in United States . . . some of them since 1954. To supplement this program, Diamond has acquired the U.S. rights to the Broman-Ekstrom system, of which there are more than 800 successful installations in Europe.



AIR HEATER
CROSS SECTION

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It has complete information, including data on shot lifting methods. For better boiler cleaning at lower cost, the answer always is Diamond.



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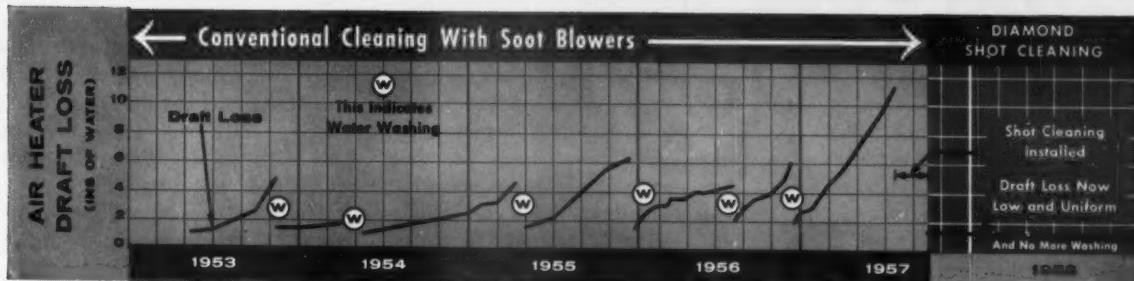
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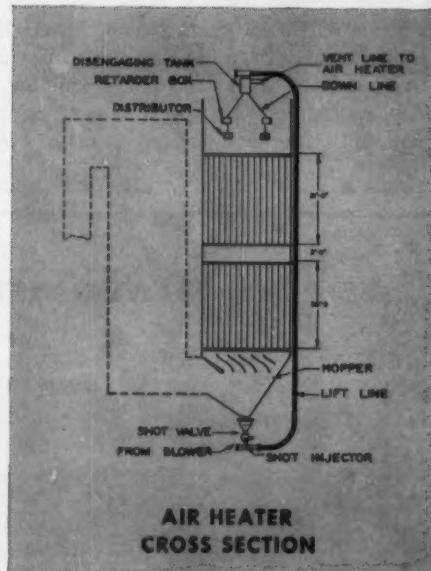
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lina as a location for their laboratories is interesting.

¶ Approximately 1000 scientists and engineers are on the faculties of the three schools in the area. They are receptive to cooperative efforts with their industrial counterparts. ¶ The geographical antecedents of these faculty members, their level of competence, and the low turnover rate is clear evidence that the area is conducive to the maintenance of a stable research staff.

¶ The combined resources of the three institutions offer advanced work through the doctorate in virtually every branch of science and engineering.

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¶ The climate permits outdoor living for a substantial portion of the year and yet there is a definite change of seasons.

¶ Recreational facilities are unusually good in terms of organized

sports, the proximity of both the ocean and real mountains, an abundance of lakes and streams for fishing and boating, and the opportunity to play golf year-round.

Research for Consultants

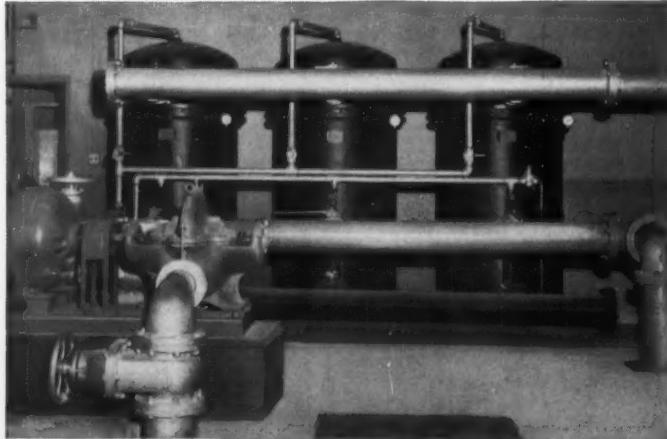
Consulting engineers, except for those concerned with site location and planning, may well wonder how this lecture can have any possible meaning for them. Yet a consulting organization faces many of the same needs as industry if it is to survive. More and more consulting engineering firms find that they need to engage in research. It is clear that the technological developments resulting from research are of vital interest to consulting engineers who are preparing now for the problems which will confront them in the future.

Consulting firms share with industry the problems associated with the maintenance of a stable and competent staff. Furthermore, many consulting firms look to the

universities for specialized assistance where it would not be practical to retain persons in highly specialized fields on a full-time basis. For these reasons some large consulting firms are actively considering the establishment of branch offices in the vicinity of universities. Some smaller consulting firms have moved their entire organizations into such an environment. While this has been done more frequently by firms in such specialized fields as nuclear engineering and space technology, it also is being considered by less specialized consulting firms.

Though this approach may seem strange to many consultants, it has many advantages. The healthy research climate of the campus could contribute new solutions for old problems, staff members could easily pursue advanced studies, and office costs probably could be reduced. In addition, "moonlighting" faculty members could be kept under close surveillance. □

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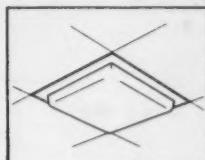
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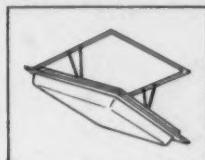
HAWAII
Honolulu:
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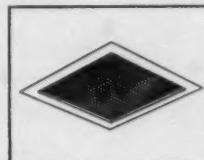
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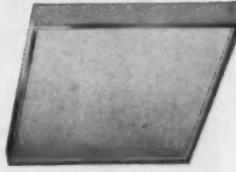
Calculites complement your precision detailing. Example: the new formed glass unit above exactly replaces a 12" x 12" ceiling tile, fits perfectly flush with the finished ceiling surfaces.



Calculites are efficient lighting instruments. Example: Torsionite spring above permits safe, easy relamping, pulls down from any side. Foam gaskets provide tight seal.

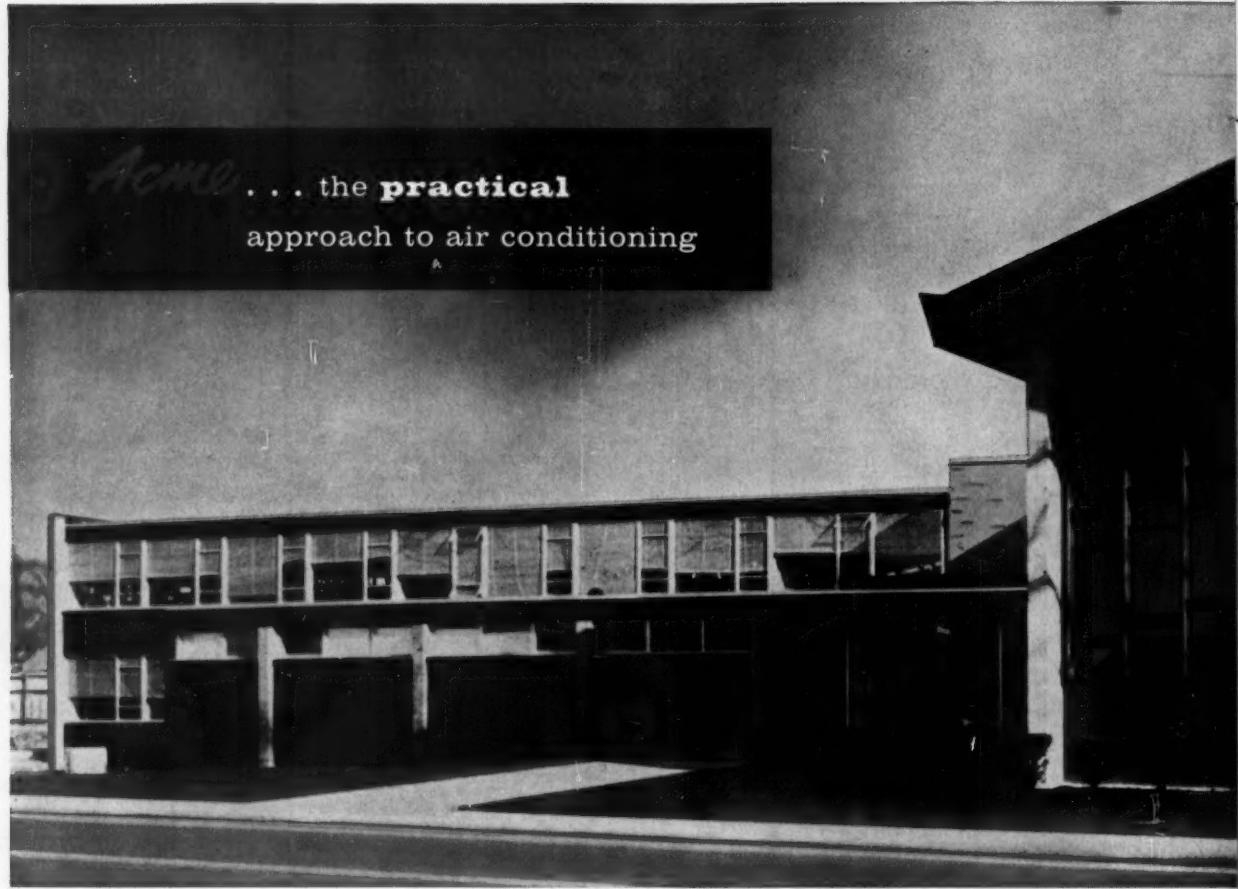


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That's right! A 75-ton Acme cooling system for comfort conditioning the temple area, meeting rooms and catering facilities at the Jewish Community Center, West Hempstead, Long Island, was installed and in operation in a period of just *two weeks* . . . an undertaking that would normally require closer to *two months* to complete.

That's a reduction in installation time of approximately 75% . . . a fact that can be attributed in considerable measure, certainly, to the excellent caliber of service rendered by the Warren Contracting Corporation, Bethpage, Long Island . . . a fact that can also be attributed to the Acme equipment used. For Acme system components offer easy-to-handle lightness, space-saving compactness, factory-

packaged simplicity . . . features that are attested to by Mr. Calvin Berch, Warren Contracting engineer who, with particular reference to Acme's Flow-Therm chiller, states: "We are extremely pleased with the Acme cooling unit. It's a neatly packaged, lightweight, compact unit which fits into tight quarters and requires a minimum of floor space."

Acme advanced engineering has resulted furthermore, in greater capacity, better efficiency, less maintenance per cubic foot, per pound, per dollar invested than you'll find in any other air conditioning system equipment currently on the market.

So, if you're looking for a *practical* approach to your air conditioning needs, look to Acme.



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COMMUNITY
CENTER
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WEST
HEMPSTEAD

COMPLETE SYSTEMS FOR EVERY AIR CONDITIONING REQUIREMENT



Tested and certified
packaged chillers



Single and multi-zone
air handling units



Cooling towers and
evaporative condensers



Self-contained
air conditioners

Acme
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MANUFACTURERS OF QUALITY AIR CONDITIONING AND REFRIGERATION EQUIPMENT SINCE 1919



Scraps & Shavings

help in finding a way to reduce the mounting cost of controls, and to simplify control systems.

Concrete Transmission Tower

The firm of Schupack and Zollman of Stamford, Connecticut has been retained to design a concrete transmission tower for extra high voltage lines. The project is being sponsored by 34 active and associate members of the Prestressed Concrete Institute. The new tower will be approximately 90 feet high with a 90-ft long cross arm.

Sanitary Engineering Manpower

According to a recent government survey there are about 6000 sanitary engineers in the United States. About one-fourth are in management or administrative positions, and another fourth are in consulting firms. Forty percent of the first group hold advanced degrees and 33 percent of the latter. Median salary of all sanitary engineers is \$8300, for management-administrative personnel \$9000, and for consultants \$9700.

Seismograph for Sewer Trenches

The Metropolitan Sewer District of St. Louis is using a seismograph to determine the presence of rock along sewer trench lines. The average depth of a rock layer can be determined for a distance of approximately 100 feet with one setup.

Computer Standardization

As a result of a national conference under the auspices of the American Standards Association, the first steps have been taken on the national and international standardization of office machines and data processing equipment. An international round-table conference has been initiated by the Swedish Na-

tional Committee of the International Electrotechnical Commission. It will discuss the possibility of an international code, or machine language, by which information can be fed to data processing equipment and digital computers. This will make possible the use of data programmed for one computer in any other computer, without recoding.

Sewage Lagoon Study

Washington State Institute of Technology announces the receipt of a \$16,100 U. S. Public Health Service grant for a study of anaerobic-aerobic sewage ponds. Specific aim of the investigation will be to determine the types of biological organisms which contribute to stabilization in anaerobic-aerobic lagoon systems at high loadings, and to relate them to the physical and chemical changes which occur in the stabilization process.

Heat Pumps

Electrical engineers were told that heat pump acceptance, as a practical method of heating as well as cooling, is growing. At the Mid-winter General Meeting of AIEE, M. J. Wilson of the Carrier Corporation pointed out that professional engineers must be given much more information on equipment performance so they can design heat pump cycles without an undue penalty on engineering costs. He pointed out that consulting engineers may be reluctant to recommend heat pumps if they require excessive design time.

1975 to be Big Year

According to economists at Arthur D. Little, industrial research consultants, gross national product in the U. S. will reach \$835 billion,

Rhode Island Uses Consultants

In announcing that Rhode Island now has engineering plans being drawn by private consultants for the entire North-South Freeway from Pawtucket to Warwick, State Public Works Director Angelo A. Marcello made it clear that the state intends to continue to use consultants. He made public a list of consultant contracts for freeway and other projects, pointing out that state engineers were already overworked by the load from secondary road projects and reviewing of the work of consultants. Governor Del Sesto points out that unless the state continues to use consultants it will never get its roadbuilding program finished.

Customer's Forum

Richard T. Baum, partner in Jaros, Baum & Bolles, Inc. and Lewis L. Pierce, executive vice president of William H. Singleton Co., mechanical contractors, discussed the relationship of their firms with manufacturers of air conditioning equipment before 126 representatives of the industry at York, Pennsylvania. Baum pointed out that consultants need complete and accurate details on engineering performance, price structure, and space requirements. He called for closer cooperation between architect, engineer, contractor, and manufacturer. He also asked manufacturers to



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Don't buy switchboards blind. Most of your switchboard dollar goes into the circuit breakers. Be sure you know what make circuit breakers you are going to get before you buy your switchboard. And if it isn't I-T-E, kick like crazy. Because I-T-E gives you more value. Yet you pay no more. Want proof? Among independent switchboard builders everywhere, I-T-E is first choice.

**Write today for the new bulletin on I-T-E molded case circuit breakers.
I-T-E Circuit Breaker Company, Dept. SA, 1900 Hamilton St., Philadelphia 30, Pa.**



I-T-E CIRCUIT BREAKER COMPANY

**More than paid for itself
in... 20
MONTHS!**

A steel mill installed this Green Aerodyne Dust Collector to prevent coal dust wear on the blades of their new turbo-blower.

This turbo-blower ran 24 hours a day, 7 days a week, for 20 months.

Then, for the first time, it was shut down for inspection. They removed the top to inspect blade wear. Did the blower need a reblading job—a job that would cost much more than the total installation costs of the Green Aerodyne Dust Collector?

No. They just re-installed the top and ordered the turbo-blower back into continuous operation and ticketed the next inspection 18 months hence.

Oh yes, when will the Aerodyne Dust Collector wear out? Nobody seems to know. Its life-in-use seems to be practically unlimited.

★ These Green Aerodyne Dust Collectors really do their jobs. Might save you a considerable sum, too. We'd be happy to show you how.

Green

THE GREEN FUEL ECONOMIZER CO., INC.
BEACON 3, NEW YORK

based on a projection from 1930. Population will rise to 235 million, with a labor force of 94 million. The average work week will be cut to around 35% hours, but productivity will soar to a record of \$5.14 per man-hour vs \$3.29 per hour in 1957. Power requirements to meet higher living standards will exceed 2100 billion kwh compared to 600 billion in 1957.

Association of the Professions

Membership in the newly organized Michigan Association of the Professions is limited to members of the State Medical Society, the State Dental Association, the State Bar, the Society of Architects, or the Society of Professional Engineers. Of the nearly 22,000 members of these five charter societies, approximately 3200 have joined the Michigan Association of the Professions. The percentage of members of each of the charter societies to join this new organization is indicative of the current status of the professions and provides a pretty good pecking order for the professional barnyard. Lawyers apparently hold the highest rank, while engineers are unfortunately at the bottom. The membership percentage figures are: lawyers 6%; doctors 15%; dentists 22%; architects 23%; and engineers 28%. From this we can assume that lawyers see the least advantage to themselves in associating with other professions while engineers hope that some of the status of the other professions will rub off on them.

Who Will it Be?

By now, the wheels should be turning to decide what the policy will be in the selection of an engineer and/or engineers for the 1964 World's Fair in New York City.

So far it has been impossible to get anyone in authority to discuss plans for the Fair. Thomas J. Deegan Jr., New York City public relations man, reported that the president of the Fair was to be announced in mid-February, and this



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one room building

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1960 . . . Present plant site in Barberton
covers 10½ acres with 11 buildings.



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Fifty years of continued growth and expansion is a tribute to the Ric-wil helically corrugated prefabricated insulated piping systems.* Systems that are engineered in correct basic design and quality built. Each unit, accessory and fitting is entirely prefabricated in factories equipped for this exclusive work. All conduit is pre-tested before delivery to the job site . . . in short . . . a system that offers the greatest strength and thermal efficiency obtainable for distribution piping.

Complete literature is available on the many types of systems . . . it's yours for the asking.

Covered by U.S. Patent 2330966, RE. 22988, 2378214. Other patents pending.

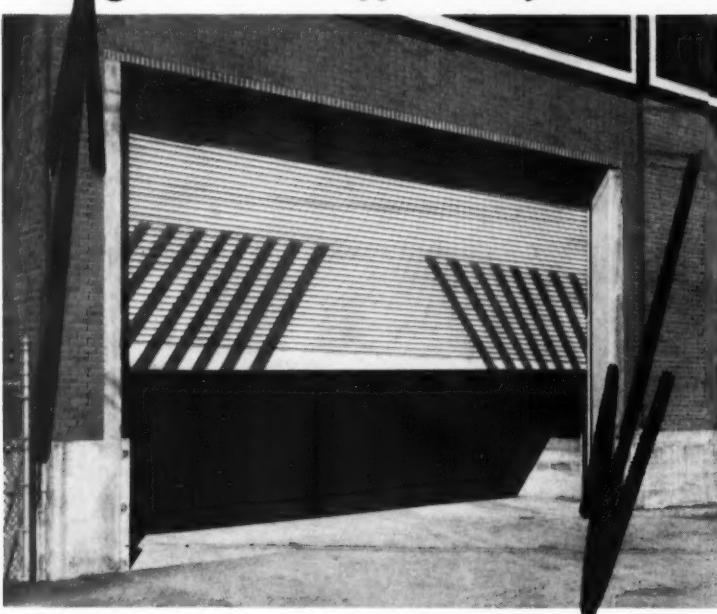
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of Exceptionally High Thermal Efficiency



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UP goes door efficiency —



as door costs go DOWN, with Kinnear Rolling Doors

The coiling upward action of Kinnear Rolling Doors saves time, manpower, and money!

The curtain of interlocking steel slats, originated by Kinnear, provides vertical door action at its very best!

All floor and wall space is fully usable at all times.

Even ceiling areas remain com-

pletely clear; leaving maximum room for use of hoists, lift trucks, and similar equipment.

When closed, the doors form all-metal barriers against wind, weather, intruders, and vandals.

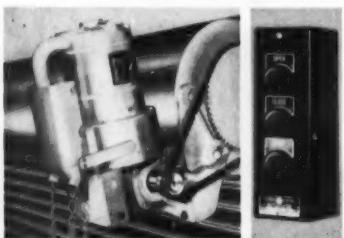
Steel or Aluminum

Kinnear Rolling Doors are made of steel, aluminum, or other metals. Built to fit any opening in old or new buildings. Motor, manual, or mechanical control.

Steel Doors Heavily Galvanized

Heavy, hot-dip galvanizing gives Kinnear's steel doors lasting resistance to corrosion and the elements (1 1/4 oz. of pure zinc per sq. ft. of metal, ASTM standards). Kinnear Paint Bond makes them ready immediately for thorough coverage and adherence of paint.

Write for full details on Kinnear Rolling Doors.



Kinnear Power Operators give time-saving, push-button control of Kinnear Rolling Doors — from a single point or any desired number of convenient locations.

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ROLLING DOORS
Saving Ways in Doorways

man then would be in charge of future details on how the Fair is to be handled. However, about two weeks before Deegan made this statement he spoke at a luncheon of the Commerce and Industry Association of New York and he was introduced as "chairman and president of the Fair Corporation."

Meanwhile, Engineers Joint Council is prepared to go into action as soon as the president and committee have been announced. Professor Jules Garrels, of Columbia University, has been asked by EJC to work as closely with the Fair committee as possible to be sure engineering is not overlooked in favor of science in Fair exhibits.

Investigate Investigators?

As the Federal-aid highway program falters, the House Public Works Committee has sent the Blatnik Committee on its way with a \$475,000 fund available for investigating the highway program in 1960. By way of comparison, it should be noted that total Public Works Committee expenditures during 1959, including expenditures for the investigating staff, were \$79,147.95.

Something New in Georgia

Consulting engineers, along with other professional persons, now have to pay an annual license fee in order to practice in the City of Atlanta. Accountants, architects, attorneys, chiropractors, dentists, engineers and land surveyors, foresters, physicians, optometrists, osteopaths, podiatrists, and psychologists had until Jan. 12 to pay the \$50 licensing fee. The fee is levied individually against all partners in a firm. Penalty for not having a city license is \$100 and/or 30 days.

Watch the Mail

According to the Industrial Relations News, happily employed engineers are getting mail and telephone calls offering new jobs. Some of the mail is sent to the engineers at their offices. Most companies

Costs a *little* more
...gives MUCH more

To have fixture BALLASTS that wear this Certification emblem may cost a little more, than for non-certified ballasts . . . but you get MUCH more.

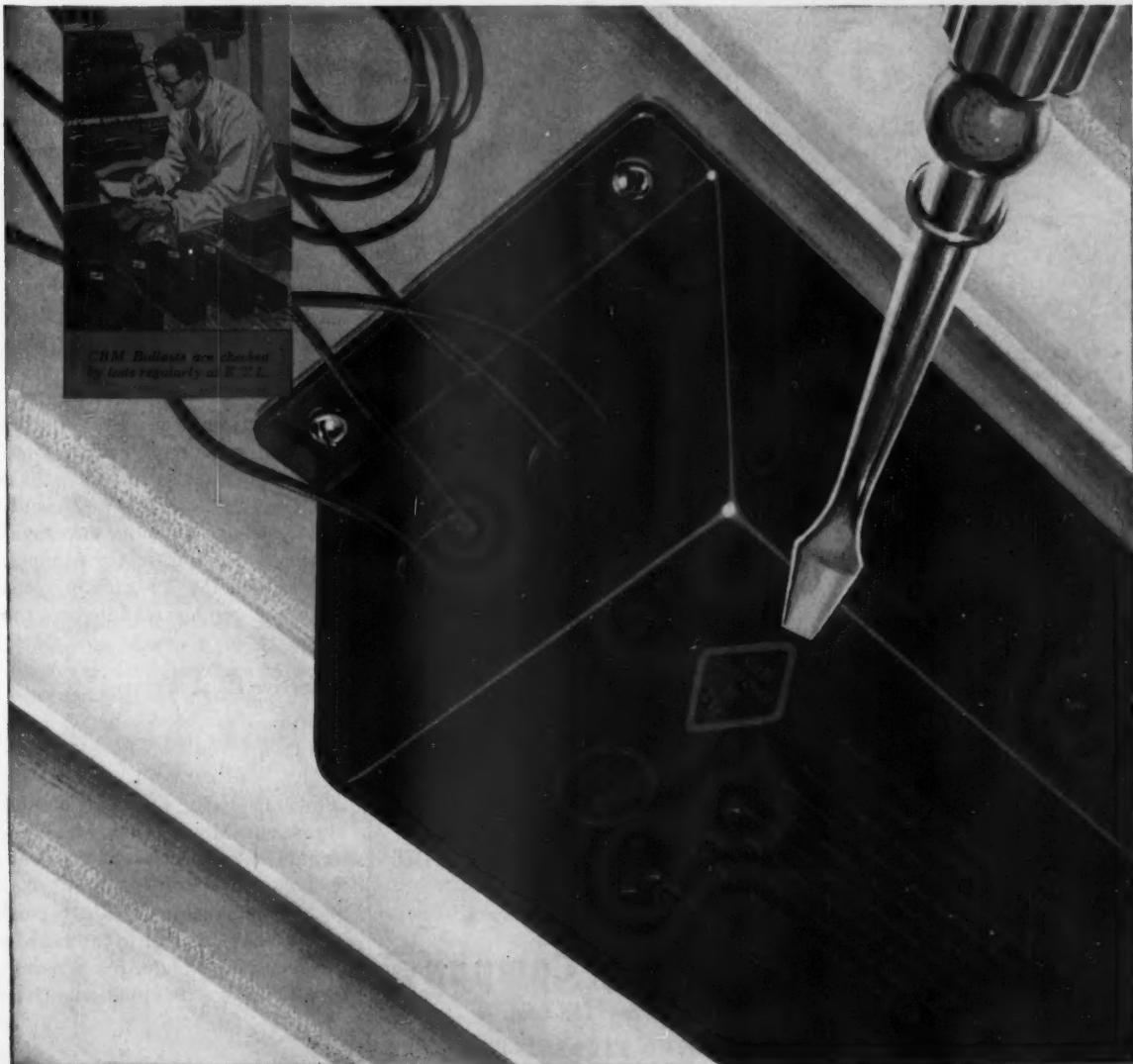
More and better materials in the ballast itself . . . more copper, more steel, and more protective and corrective devices . . . and more inspections, finer workmanship . . . to assure the user "tops" in fluorescent performance. Perhaps this extra value is why an ever increasing number of ballast users find that specified CBM performance . . . checked and certified by ETL . . . is well worth having.

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For institutions and other structures where a high capacity, low contour ventilator is required.

- 25 BASIC selections of tip speeds and capacities in direct drive models.
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- CAPACITIES from 65 to 27,648 CFM.
- HORSEPOWER ratings from 1/60 to 7 1/2.
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- LOW PROFILE heavy gauge spun aluminum housings.
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- DAMPERS available in drop-in sleeve type, automatic back-draft or motor operated.
- BURT DESIGNED for minimum noise levels.
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Write for Burt Data Book SPV-101-H.
It supplies quick data on Burt's complete line of modern Roof Ventilators.

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MEMBER AIR MOVING & CONDITIONING ASSOCIATION, INC.

agree that mass mail is not for the engineering field, pointing out that it lowers employment standards and increases job turnover. Besides, there always is a chance that a mass mailing will include the name of a customer or client by mistake.

Galileo Misinterpreted

According to Dr. Duane H. D. Roller, Associate Professor of the History of Science at the University of Oklahoma, the role of Galileo has been badly misinterpreted. He told an audience at the Case Institute of Technology that America's inability to produce first-rate scientists may well stem from the time honored impression that Galileo's greatest contributions were the result of experiment rather than creative thinking. Dr. Roller states that the anecdotes about Galileo's experiments are spurious and that he sought for an understanding of nature through thought and contemplation.

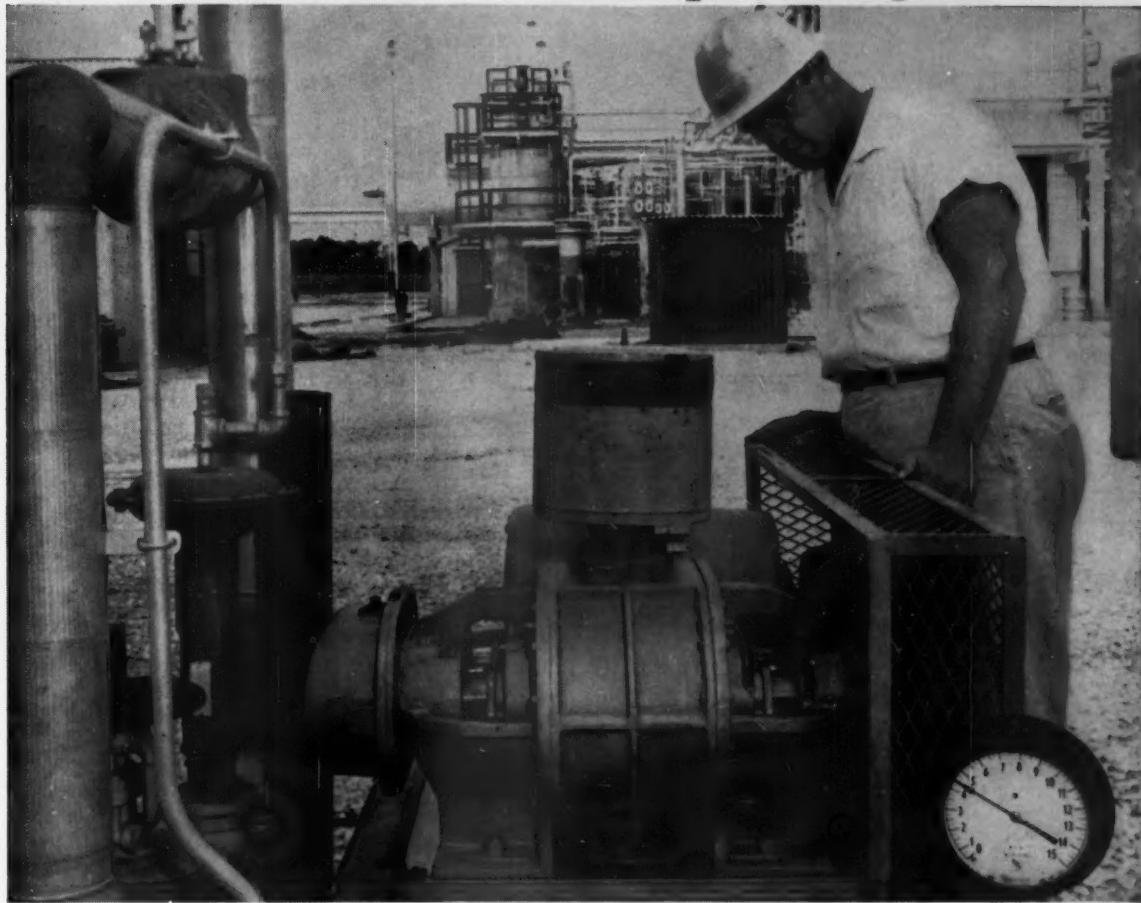
Frontal Attack on Congress

The Consulting Engineers Association of Oregon has attacked head-on the problem of private vs public engineering. In a meeting with Senator Neuberger and his secretary, Lyle Tuppin, it was agreed to contact directly the specific chairmen of committees in Congress who receive and handle bills involving the interests of consultants which result from investigations pursued during the summer. In addition, the Association plans to direct regular mailings to the Oregon Congressmen.

Reflective Road Surfaces

According to the results of a cooperative study of color-coated reflective road surfaces by the Minnesota Highway Department and Minnesota Mining and Manufacturing Co., traffic flow can be greatly facilitated by this new road treatment. Treatment of a typical interchange brought favorable driver response under five separate conditions of illumination. Over

where blower failure would spell Danger



Sutorbilt blower at Polymer Chemicals Division plant in Baton Rouge, La. Blower is required at a critical phase of catalyst activation in a new Phillips-type polymerization process.

W. R. GRACE DEPENDS ON A SUTORBILT ROTARY, POSITIVE-PRESSURE BLOWER

At W. R. Grace & Co.'s new Polymer Chemical Division, the catalyst for a new, high-density polyolefin production process must be protected in a pressurized air stream. A doubly-dependable Sutorbilt rotary positive-pressure blower was selected for these three important reasons:

1. Contamination must be avoided

Long-lasting, air-tight, Teflon seals and lack of lubrication in compression chamber prevent air contamination in a Sutorbilt blower.

2. Breakdowns would be dangerous

Simple, rugged, precision construction (only rotors

and bearings move) means reliable service. Unit chosen by Grace has been in continuous operation for well over a year without repairs.

3. Pressure must be positive, constant

The two, counter-rotating "figure eight" Sutorbilt impellers produce a positive-pressure, *metered* air supply.

Sutorbilt blowers and gas pumps are precision-built to deliver air or gas in capacities up to 20,000 cubic feet per minute—at pressures up to 10 pounds. Write today for complete, illustrated literature on these efficient, dependable blowers.

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Major surgery in Mt. Sinai Hospital, New York, being performed with illumination from windows and one emergency light.

Protect against power blackouts... specify

**KOHLER
ELECTRIC PLANTS**

Widespread hazards, inconvenience, discomfort and loss occurred in places without standby power during the 13-hour power failure in New York's Manhattan last summer. Hospital surgery was performed

without proper lighting; patients were served by candlelight. Buildings of many kinds had no use of lights, air conditioning, elevators, freezers.

Kohler electric plants are reliable, easy to install for emergency power made vitally important by today's increasing dependence on electrical equipment. To help you write specifications for varied applications, Kohler Co. will send on request a manual with complete data on sizes from 1000 watts to 100 KW, gasoline or diesel.

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**KOHLER CO.
Established 1873
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MODEL 100R81
100 KW, 120/208
volt AC.
Stand-by.
Remote start.



KOHLER OF KOHLER

Enamelled Iron and Vitreous China Plumbing Fixtures • All-brass Fittings
Electric Plants • Air-cooled Engines • Precision Controls

1000 interviews were held and electronic measuring devices were used to gather objective data. The reflective lighting system can be color coded for identification of turnoffs, points of merging traffic, and through lanes.

Educators and Ducks

On the surface, engineering education in the U.S. looks like a swimming duck. Also, like a swimming duck, it is paddling rather furiously underneath. So M. L. Manning of South Dakota State College told members of AIEE at its Winter General Meeting,

Just as electronics, rocketry, and advanced research have brought new dimensions to engineering knowledge, so curricular reforms can bring advances to the profession. It is Manning's contention that the old distinctions between engineering fields at the undergraduate level are breaking down, and that a basic engineering course can well occupy the present four year curriculum. Specialization can occur at the graduate level, allowing the inclusion of the humanities in the undergraduate program. Shop courses should be eliminated, and present textbooks drastically up-dated.

Golden Gate Bridge Study

The firm of David B. Steinman has been selected for a \$50,000 study to determine whether the Golden Gate Bridge can carry rapid transit trains without impairing its safety. Awaiting the results of this study is a contemplated \$500 million bond issue referendum to expand the area's public transportation system.

Phoenix Sewer Needs

A report by the engineering firm of Yost and Gardner predicts that Phoenix will need \$34.7 million in new sewers by 1980. It was suggested that sewer funds be raised through general obligation bonds to be retired by sewer service charges to non-city residents. ▲

Artist's conception of electric furnace arc, based upon high speed photographs

CRAK DOWN on electric melting costs

HYDRO-ARC electric furnaces keep arcs burning at peak intensity every moment—and turn extra wattage into melt. The key: instantaneous electrode movement, monitored by the very energy of the arc itself.

Air counterbalanced electrodes and a unique dual motor hydraulic control circuit virtually eliminate troublesome inertia or mechanical lag. When turbulence in the metal charge effects arc gap, electrode reaction is immediate—readjustment is exact! Here is electric melting efficiency you may not have thought possible . . . cost reductions that open many new applications for fast, clean, economical electric melting. Hydro-Arc may put a fresh light on your own plans for additional melting, smelting, or other heating facilities.

FOR MORE FACTS, write for Hydro-Arc Bulletin No. FO-10, or ask a Whiting furnace engineer to call. No obligation. *Whiting Corporation, 15620 Lathrop Avenue, Harvey, Illinois*



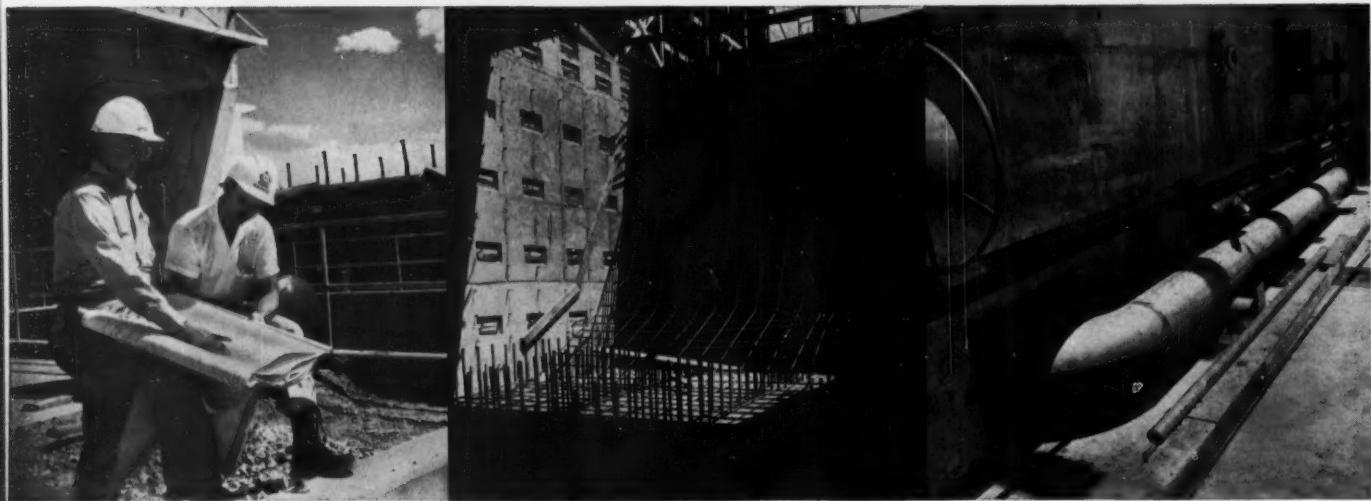
87 OF AMERICA'S "FIRST HUNDRED" CORPORATIONS ARE WHITING CUSTOMERS



WHITING

MANUFACTURERS OF CRANES; TRAMBEAM HANDLING SYSTEMS; TRACKMOBILES; FOUNDRY, RAILROAD, AND SWENSON CHEMICAL EQUIPMENT.

Somewhere east of Laramie, on one of Wyoming's plains, you'll find the strangest government housing project ever built. Six concrete and steel buildings are being constructed to house Atlas missiles. The site is one of the operational intercontinental missile bases to be operated by the Strategic Air Command. This base is being constructed on the surface. Follow-on bases will burrow deep into the earth. In all these systems, the Air Force puts much emphasis into ground support equipment. Virtually all of the material can be purchased from one firm — United States Steel. Whether it's carbon



The U. S. Army Corps of Engineers is constructing this operational intercontinental missile base in Wyoming. In front of the partially completed Launch and Service Buildings are Col. Sidney T. Martin, in charge of construction, and Maurice K. Gruber, a construction engineer for the Corps.

This is the inside of the blast pit of one of the launcher buildings. In all six of these buildings there are 1,040 tons of structural steel, 1,950 tons of reinforcing steel, over 48,000 tons of concrete aggregate, blocks and cement, and 8,040 tons of mechanical steel items.

Fuel lines and process piping are Stainless Steel and operate at pressures up to 15,000 psi. The pipes are kept almost surgically clean to prevent contamination of fuel and subsequent malfunction. Vapor degreasing and chemical cleaning processes are used on the pipes.

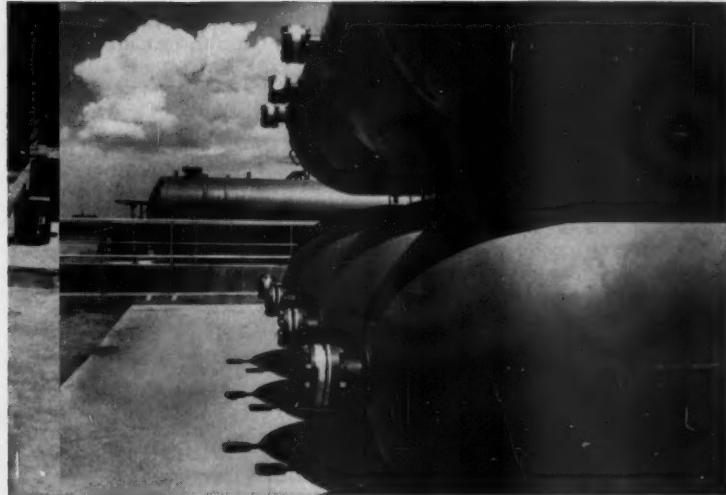
steel, high-strength low-alloy steel,
ultra high-strength alloy steels, Stainless Steel, steel fence, electrical cable, cement or wire rope, United States

Steel maintains the technical services to assist in solving any problem on materials for ground support. When a ground support program goes to the drawing board, consult with

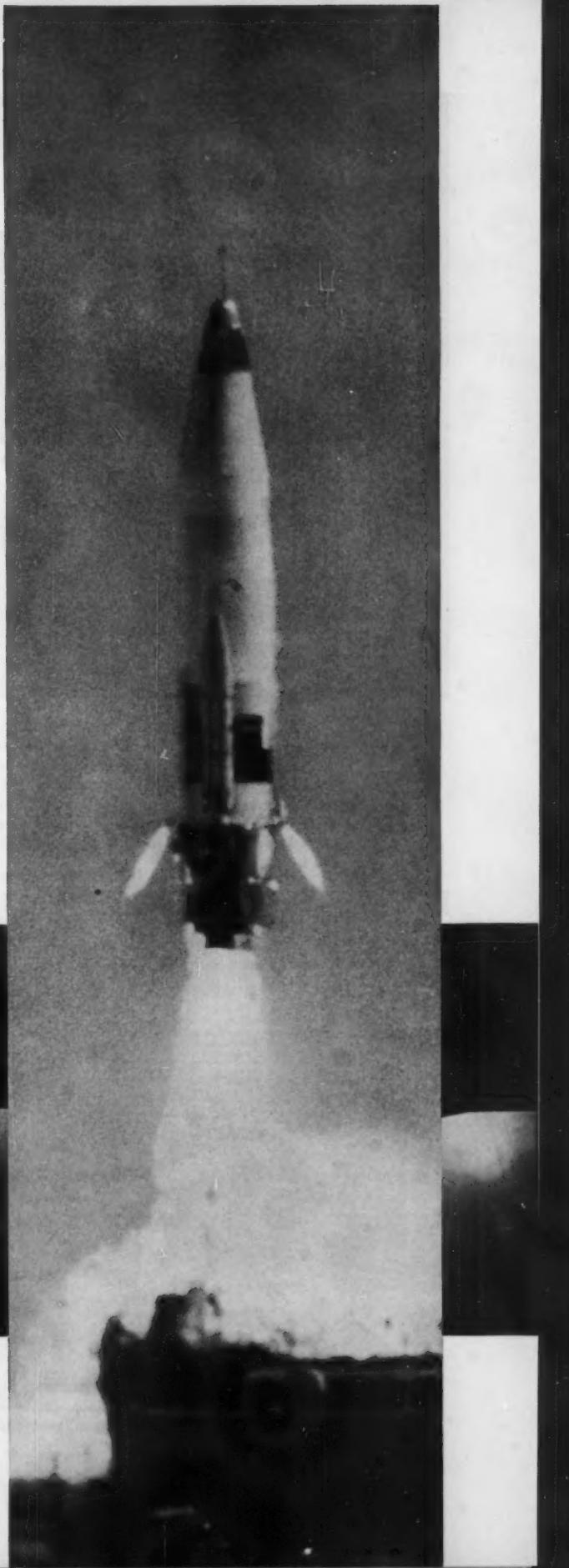


United States Steel

USS is a registered trademark



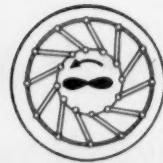
The Atlas is powered by a cluster of liquid propellant rocket engines that burn liquid oxygen and RP-1, a kerosene-like hydrocarbon fuel. 192 pressure tanks fabricated from alloy or Stainless Steel plate at this site store liquid and gases—liquid oxygen and nitrogen and helium gases which are used to inject the fuels into the missiles.



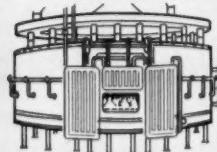
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ADAPTS TO YOUR HEAT TRANSFER PROBLEM

a wide variety of designs and sizes



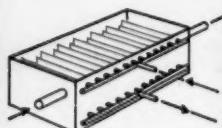
ALL TYPES
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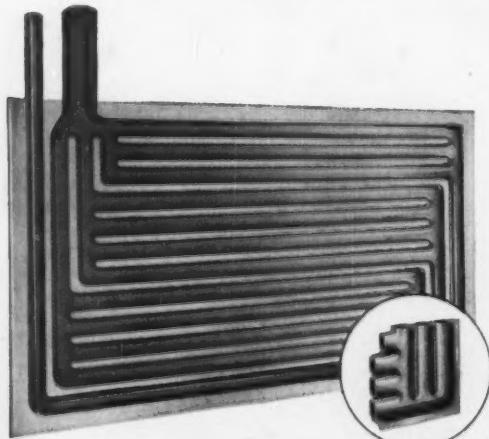
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RECOVERY

PLATECOIL is the versatile, factory fabricated answer to heat transfer problems of all kinds. You can apply PLATECOIL to all types of tank and process heating and cooling — open tanks, closed tanks, agitated tanks, deep tanks, jacketed tanks, sumps, kilns, ovens and many others. Basic PLATECOIL types include header and serpentine designs in single embossed, double embossed, flat, rolled and banked units. They are available in mild steel, stainless steel, Monel, Ni-o-nel, Hastelloy B, Hastelloy C, nickel, and many other metals. Special designs, surface finishes, structural parts and connections add to their versatility. Operating pressure now rated up to 250 psi.

NEW MULTI-ZONE* PRINCIPLE PRODUCES MORE EFFECTIVE HEAT TRANSFER



Multiple headers with multiple condensate returns provide better steam distribution and more total effective heat transfer area in the new MULTI-ZONE PLATECOIL. FREE-FLO action, without condensate trapping increases processing production through faster "start-up" and extremely fast temperature recovery. This reserve capacity also holds temperature variations to a minimum. PLATECOIL eliminates problems of engineering, fabricating, installing and maintaining pipe coils. PLATECOIL units are lightweight and easy to handle. They are compact and save tank space. Deposits do not build up on streamlined PLATECOIL surfaces as they do on pipe coils. All stainless steel and alloy PLATECOIL units affected by cold working are annealed and pickled after fabrication to return the metal to its original condition and thus eliminate the probability of corrosion due to internal stresses and carbide precipitation. PLATECOIL is also relatively simple and economical to remove, clean and re-install. In most cases there is no need for threaded joints within the solution to corrode or leak.

Investigate the possibilities of PLATECOIL for your specific problem.

*Patented
Send for Bulletin
PBS for more data.

Tranter Manufacturing, Inc.

LANSING 9, MICHIGAN

PLATECOIL® DIVISION



Men in Engineering

Carl E. Asbury has been appointed chief electrical engineer of Commonwealth Associates, Jackson, Michigan. Asbury, a member of the firm since 1946, formerly was supervisor of Commonwealth's electrical application section. M. C. Westrate, who had been serving as the firm's chief electrical engineer, has been appointed chief systems engineer, and J. A. Elzi, formerly chief systems engineer, has been made coordination engineer.



ASBURY

NILAND

John J. Niland has been appointed assistant engineering manager of Stone & Webster Engineering Corporation. Niland, a member of the firm since 1941, was assigned to engineering administration in 1956 and also has served as assistant to the president of Associated Nucleonics, Inc., a subsidiary of Stone & Webster engaged in atomic energy work.

Col. Carlos Bobeda came all the way from Asuncion, Paraguay, to Miami, Florida, a distance of 7000 miles, to convey his government's appreciation officially to Rader and Associates for work done on the re-

cently completed \$12 million municipal water system there. The Miami engineering and architectural firm designed and supervised construction of the complete supply, treatment, and distribution system and is supervising its operation. The project was financed largely by loans from the Export-Import Bank and Development Loan Fund which were granted on the basis of the economic feasibility report made by Rader and Associates in 1955. Since operation of the system began last August 15, service has been installed to 8640 of an eventual 20,000 individual connections.

Richard T. Richards has joined Burns and Roe, Inc., New York City consulting engineering firm, as a supervising civil engineer. Richards, previously employed by Ebasco Services, Inc. and an officer for three years in the Navy's Civil Engineer Corps, has had a wide experience with steam, electric, and hydroelectric power plants and has authored many papers on power plant hydraulic design and practice.

At its Winter General Meeting held last month, the American Institute of Electrical Engineers presented its John Scott Award to Dr. Dean A. Lyon, scientist and consulting engineer of Woodbridge, Connecticut, in recognition of his invention of the method of producing the first practically useful optical coatings for the reduction of light reflections. The award was

established 143 years ago by John Scott, an Edinburgh, Scotland, chemist, who bequeathed funds to the City of Philadelphia to reward men and women who make useful inventions.

James A. Commander has joined the special accounting department of Commonwealth Services, Inc., New York management and engineering consulting firm.

Colonel Frederick R. Knoop, Jr. has returned to the field of private practice of engineering in the office of Whitman, Requardt and Associates of Baltimore after six years as vice president in charge of construction projects for the general contracting firm of Charles R. Schriven Co., Inc., of Baltimore.

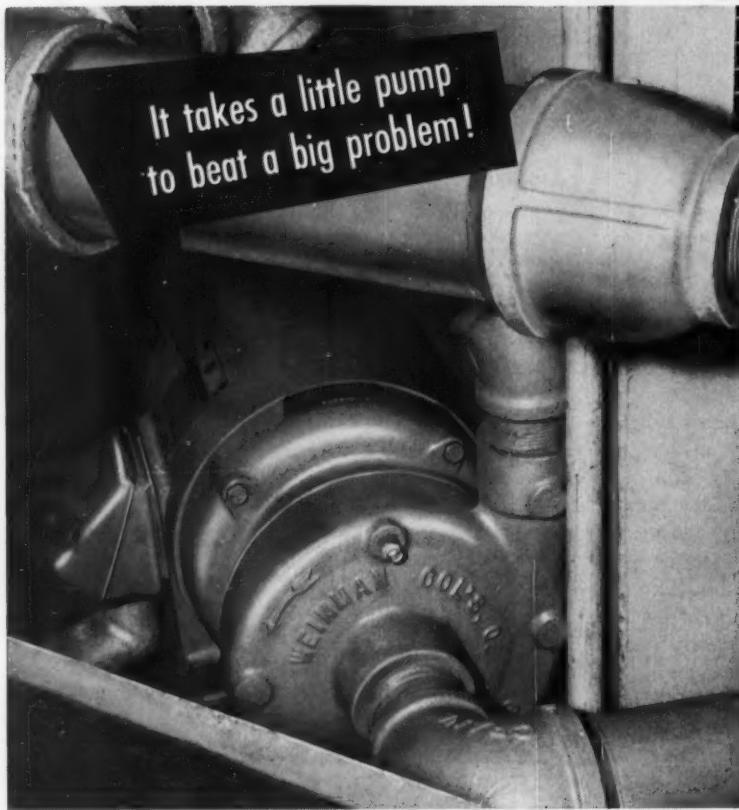
Charles T. Blair, vice president and chief engineer of Wilsey, Ham and Blair Engineers and Planners, Millbrae, California, has been elected the new president of the Bay Counties Civil Engineers & Land Surveyors Association.

Other new officers include: vice president, Robert W. Heid, Heid & Heid, Napa; secretary, Harl V. Pugh, R. M. Towill Inc., San Francisco; and treasurer, Don E. Ryan, J. Y. Long Co., Oakland.

The association's membership includes more than 40 civil engineering firms in eight counties.

Eugene A. Krannich has been appointed associate engineer of Sauter, Ritchie & Doane, consulting engineers, of Cuyahoga Falls, Ohio. Krannich, a member of the firm since 1956, will supervise the design department.

Lester D. Lee, president of Hitchcock & Estabrook, Inc., engineers-architects of Minneapolis, Minnesota, announces the firm's expansion and entrance into the electronics consulting engineering field. The new division will handle the consulting engineering phases of all electronics systems, computers



Compact WEINMAN AC pumps simplify installation of air conditioning systems

Lack of space can be a real problem in air conditioning installations. The best way to lick this difficulty is with Weinman AC air conditioning pumps. These compact, versatile units take up little space, can be mounted in any position and yet operate year after year without failure. One reason — ceramic floating seal seat and synthetic

carbon compound sealing washer assure long trouble-free service, leakless operation, even when handling water carrying abrasive dust.



There are over 60 models to choose from. Output ratings up to 260 g.p.m., heads up to 150', horsepower ratings from $\frac{1}{4}$ to $7\frac{1}{2}$. See your Weinman centrifugal pump specialist. He's listed in the Yellow Pages. Or, write us direct.

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Anniversary
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290 SPRUCE ST., COLUMBUS 8, OHIO

CENTRIFUGAL SPECIALISTS



and associated equipment, all types of radio, including tropospheric and atmospheric scatter, and in various navigational and radar fields concerned with space and space vehicles.

The Austin Company, engineers and builders of Cleveland, Ohio, has increased the number of its directors from nine to ten, named a new vice president, and appointed two new district managers.

John N. Beckley, vice president and eastern district manager, was elected to the board of directors at the annual stockholders meeting, at which all other directors were re-elected. Beckley joined the firm in 1941 and has been in charge



BECKLEY



EIBER

of Austin's eastern operations for the last five years with offices in New York City and Roselle, N. J.

Rollin R. Eiber was named a vice president and continues as manager for the 17-state midwest district with offices in Chicago.

E. W. Hollister has been appointed manager of Austin's 12-state Cleveland district. He succeeds C. W. Wolfe, who continues as a vice president.

Charles R. Wing has been named Austin's southwest district manager with offices in Houston. Albert S. Low continues as vice president in the southwest.

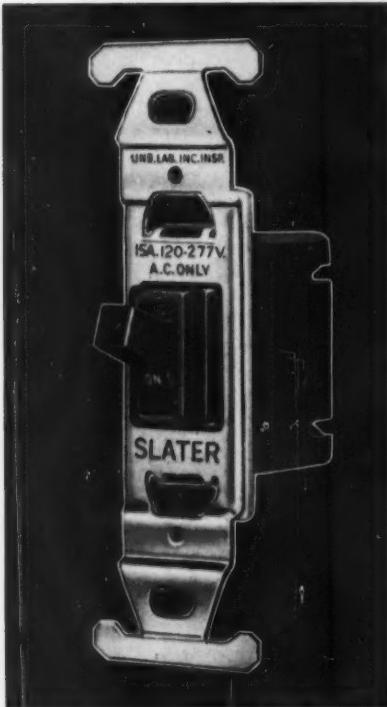
Eli Werner Cohen has been admitted as an associate of Paul Rogers & Associates, Inc., consulting engineers, of Chicago. This is in line with company policy that staff engineers become associates



**You wouldn't buy a bargain basement parachute...
or a cut-rate big game rifle...**

Don't choose less than Clarge quality for your mechanical draft service. With anything as vital as uninterrupted operation, it pays big dividends to get the best in equipment. Clarge, a specialist in building forced and induced draft fans, offers you equipment having a long-standing reputation for long-lasting service. CLARGE FAN COMPANY, Kalamazoo, Michigan.

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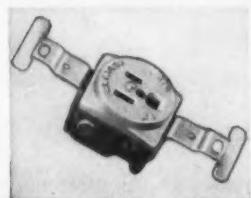
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modern,
compact
QUIET
SWITCHES
WITH
SILVER ALLOY
CONTACTS**

15 AMPS, 120-277 VOLTS*

The Slater #600 is the newest, quietest wall switch designed for fast, easy installation... cuts installation time more than 50%. In addition, the #600 features special silver alloy contacts, no-arcing characteristics. It will accept two #12 or #14 wires for thru wiring — patented side release permits use of ordinary screwdriver.

Engineering Excellence is the heart of Slater leadership in wiring devices. This is because years-ahead thinking, planning and performing at Slater is based on widest experience, backed by modern facilities that are unsurpassed in the field.

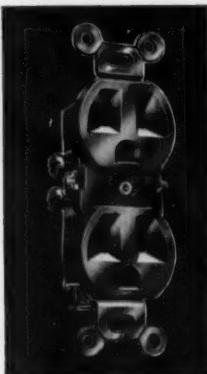
Technical Superiority in construction, materials and production techniques assure Slater contractors unexpected benefits in function and durability, as well as initial and long-range economy.



#5261—specification grade single grounded receptacle, 15 Amps, 125 Volts*



#3783—Weatherproof Flip-Lid with #3200 "U" ground receptacle, 15 Amps, 125 Volts*



#3200—3 wire grounding, duplex receptacle, 15 Amps, 125 Volts*

*Other Ratings Available

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upon successfully passing the State Structural Engineering Registration examination. Cohen also was appointed assistant chief engineer with responsibility for projects.

Forrest and Cotton, Inc., consulting engineers, of Dallas, Texas, announces the election and promotion of George M. Parker, Jr. and C. L. Shimek as vice presidents of the firm.

Robert J. Kuhn, New Orleans consulting engineer, is the recipient of the Louisiana Engineering Society Technological Accomplishment Medal for 1960. In 1927 Kuhn developed an electrical method of corrosion protection known today as cathodic protection and has pioneered its use on underground pipes and cable systems on some of America's largest pipeline and utility systems. Two of his recent developments are the salt water polarizing grounding cell for grounding cathodically protected high voltage pipe type cables and the deep ground bed for cathodic protection systems.



KUHN



RILEY

John P. Riley, internationally known construction engineer, has been appointed vice president for development of Lockwood, Kessler & Bartlett, Inc., general consulting engineers of Syosset, New York. Riley has served as construction engineer on hydroelectric, vehicular tunnel, industrial plant, flood control, and housing projects in various parts of the United States and Canada and in other countries. Before joining Lockwood, Kessler

KRALOY...

FIRST PVC RIGID CONDUIT INSPECTED AND PASSED BY UNDERWRITERS LABORATORIES*



* For direct underground burial
or encasina in concrete

Only KRALOY, yes *only* KRALOY, among all plastic conduits, now carries U-L listing — another first for KRALOY! High impact KRALOY PVC (Polyvinyl Chloride) RIGID CONDUIT... the *lifetime* conduit...the *perfect* conduit...won't rust, won't pit, won't corrode, won't support combustion, is non-magnetic and non-sparking. KRALOY needs no paint, no coating, needs no lining, and its mirror-smooth inside wall makes fishing easier than with any other type of conduit. Add these outstanding features to KRALOY's extreme light weight (see chart below) and you have the *ideal* conduit...ideal for direct burial and slab work. Installation costs can be cut drastically with light weight KRALOY PVC RIGID CONDUIT. Consider the dollars to be saved in handling and installing U-L listed KRALOY CONDUIT Cat. No. KE-1058 versus steel, *versus even aluminum conduit*:

KRALOY PVC CONDUIT is
sold only through wholesale
electrical supply houses.

NOTE WEIGHT COMPARISON — KRALOY PVC vs. ALUMINUM vs. STEEL CONDUIT
U.L. required minimum weight per 100 ft. including couplings, lbs.

K-59-29

Trade Size	1/2"	3/4"	1"	1 1/4"	1 1/2"	2"	2 1/2"	3"	3 1/2"	4"	5"	6"
KRALOY PVC	15.0	20.0	29.0	40.0	47.0	63.0	101.0	131.0	159.0	187.0	253.0	326.0
ALUMINUM	27.4	36.4	53.0	69.6	86.2	115.7	182.5	238.9	287.7	340.0	465.4	612.9
STEEL	79.0	105.0	153.0	201.0	249.0	334.0	527.0	690.0	831.0	982.0	1334.0	1771.0

For complete information on KRALOY PVC CONDUIT and installation directions, mail the coupon or write to Kraloy Plastic Pipe Co., Inc., 402 W. Central Avenue, Dept. CE-3, Santa Ana, California



Kraloy Plastic Pipe Co., Inc., Dept. CE-3
402 W. Central Avenue, Santa Ana, California

Gentlemen: Please send me your new Brochure on KRALOY PVC CONDUIT which gives complete information and installation directions.

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104 YEARS

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THIS PRODUCT



McDonald 4701 Corporation Stop — Standard A.W.W.A. thread for copper service pipe. Sizes from $\frac{1}{2}$ inch to 2 inches. A catalog of McDonald's complete line of brass goods is available on request.

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If you've got
a tough
assignment
coming up—

Call EARLE!

& Bartlett last year he was vice president and chief engineer of Ibec Housing Corporation, in charge of design, construction, and development of new techniques for work in the Caribbean and the Middle East.

Walt J. Hanna, Jr., engineer and land surveyor, Gilroy, California, has been elected president of the California Council of Civil Engineers and Land Surveyors for 1960. Hanna was president of the Monterey Bay Chapter of the Council in 1958 and 1959, and chairman of its State Legislative Committee for two years. His election to the top office of the Council culminates several years of outstanding service to this state-wide organization.

Other newly elected officers are: first vice president, Charles W. Christiansen, San Diego; second vice president, Harold Musser, Nevada City; and secretary-treasurer, William Pafford, Los Angeles.

The Council's membership consists of 250 engineering and land surveying firms in California employing over 3500 people.

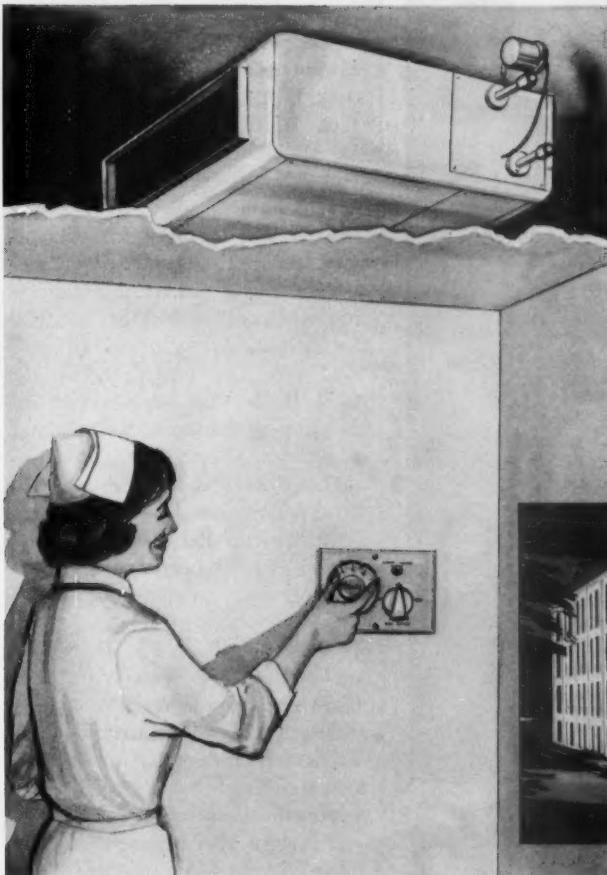


HANNA

PLAUTZ

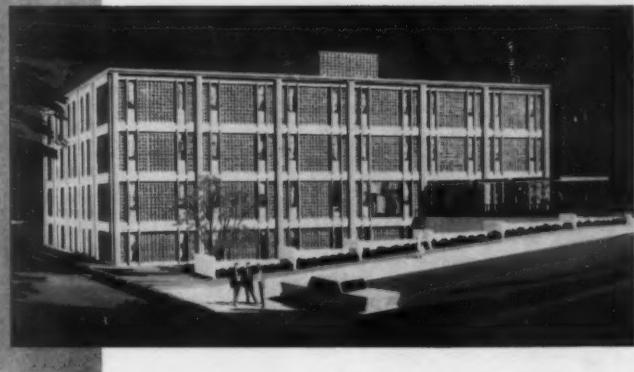
Arthur H. Plautz has joined the staff of Henry B. Steeg & Associates, Inc., Indianapolis sanitary engineering firm. Plautz, formerly with the Indiana State Board of Health and Clyde E. Williams & Associates, will serve as design engineer, water supply section.

A new engineering firm, Holway Engineers, Inc., has been formed by principals of two Tulsa engineering firms, W. R. Holway and



DOCTORS NORTH-ROADS BUILDING
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Architects: Smith & Entzeroth
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Unique use of *Marlo* fan-coil units in handsome new doctors' building

The versatility of Marlo "Seazonaire" remote room air conditioning units is graphically demonstrated in the new Doctors North-Roads Building in suburban St. Louis.

In this installation, the "Seazonaires" were recessed above a removable furred ceiling and equipped with flexible ductwork leading to ceiling diffusers. Thirty-six "Seazonaires" were installed, one unit for each suite, each with its own thermostatic and fan control and fresh air duct from the outside wall.

By using this unique system — one of the first of its kind—the architects and engineers were able to produce a building of quality design and construction without increasing initial cost and offering important savings in operating costs.

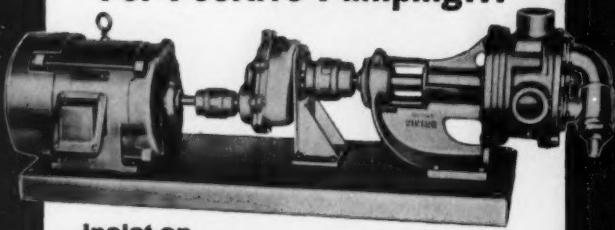
Write for 16-page illustrated brochure on Marlo "Seazonaire" remote room air conditioning units. Contains photographs and drawings of all models available, construction and performance details, examples of typical installations.

Marlo coil co.

SAINT LOUIS 11, MISSOURI

Quality Air Conditioning and Heat Transfer Equipment Since 1925

For Positive Pumping...



Insist on

VIKING ROTARY PUMPS

In your own best interests, insist upon Vikings, the **POSITIVE DISPLACEMENT** pumps. Using them, you can eliminate slow priming, vapor locks, spasmodic delivery and partial emptying of tanks. Units feature the new helical gear drive and are equipped with heavy-duty pumps which deliver from 17 to 164 gallons per minute.

Five interchangeable speed reducers permit easy change of pump speeds for handling thick or thin liquids. Maximum pressure is 200 PSI on lubricating liquids, 100 PSI on non-lubricating liquids.

For complete information, send for catalog CP, pages 27-28.



VIKING PUMP COMPANY

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See Our Catalog in Sweet's Industrial Construction
and Plant Engineer's File

in laying out your client's plant

ARE YOU GUARDING AGAINST DUST DAMAGE TO MACHINES?

Will there be dust-producing machines in your client's new plant? Such as metalworking, wood-working or pneumatic conveying equipment? If so, you should plan now for dust control.

Because dust clogs and gums up costly machinery, lowers production efficiency, causes breakdowns and higher maintenance costs. In addition, dust is harmful to the health of employees.

More and more professional men, laying out new plants and remodeling older ones, are specifying Torit Dust Collectors. Torit Dust Collectors have proved 98% efficient in removing dust. They are compact, easy to install and maintain, and cost far less than many types of dust collecting equipment.

Contact a Torit representative. He will give you dust collector specifications, performance charts, dimensional drawings, installation suggestions . . . all the information you need.

Write:

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Associates and Cornett, Wood and Associates. Officers and directors of the new company are: president, W. R. Holway; vice president, Jack B. Cornett; vice president, D. K. Holway; treasurer, W. N. Holway; and secretary, J. T. Wood. The new firm will offer engineering services in the fields of sanitary, structural, hydraulic, mechanical, and electrical engineering. Offices are located at 1850 South Boulder.

Carl Thaller has been named an associate of Samborn, Steketee and Associates, Otis & Evans, consulting engineers and architects with headquarters in Toledo, Ohio. Thaller, who has been with the firm since 1957, heads the mechanical engineering department.

James H. Quinlan has been promoted to an associate in the firm of Fred S. Dubin Associates, consulting engineers, Hartford, Connecticut. For the past three years, Quinlan has been a project engineer with the firm.

The firm also has a new home office address, 635 Farmington Ave.

Soil Testing Services, Inc., Chicago consulting soil and foundation engineers, announces the election of two new officers. They are: Clyde N. Baker, Jr., vice president, and David E. York, treasurer.

The firm name of Pullara, Bowen and Watson, architect-engineers of Tampa, Florida, has been changed to Pullara and Watson.

John A. Erickson, consulting structural engineer, Los Angeles, California, has moved his office to 4033 Sunset Boulevard, Suite Eight.

De Leuw, Cather & Company, consulting engineering firm with offices in Chicago, Boston, San Francisco, and other principal cities, announces the re-election of the following as officers of the firm: president, C. E. De Leuw; vice presi-

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LIGHTING BY miller

4' x 4'

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SINCE 1844

New...Shallow Fluorescent Fixtures with HINGED DOORS

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Whatever the job... consider
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are secure, easily operated. Main-
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handling of loose parts.

Whatever the job... discover how
Surfaceline can meet your particular
lighting needs! Write Dept. 360 at
Meriden, Conn., for catalog infor-
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dent, L. H. Cather; and chief engineer, V. E. Staff. In addition, R. H. Anderson, J. E. Linden, W. R. McConochie, and R. B. Richards were elected directors at a recent stockholders meeting.

J. L. Simpson, Jr., consulting electrical engineer, Nashville, Tennessee, has moved his office to 1719 West End Building.

Paul M. Dollard, management consultant of Ebasco Services Incorporated, has been appointed to the general management consulting staff. Before becoming affiliated with Ebasco, Dollard was president and general manager of Central Foundry Company, of New York, New York.

Astra, Inc., Raleigh, North Carolina, announces the formation of a Medical Engineering Division. Head of the new division is Daniel I. Weinberg, who has had training in both medical subjects and

electrical engineering. Work in this division will be directed towards applying new and basic data from many advanced technologies to problems of measurement, analysis, and design in medical research.

Drake, Startzman, Sheahan and Barclay, distribution and materials handling consultants, New York City, announce that Burr W. Hupp and Richard J. Sweeney have become partners of the firm. Two other recent appointments include: George R. Ogden, principal, and John R. Wells, associate.

Edward H. Amos, consulting engineer, Cleveland, has moved his office to a new building at 21877 Euclid Avenue.

Announcement has been made of the reorganization of C. G. De Swarte & Associates, consulting engineers, of Long Beach, California. New name of the firm is Greve & O'Rourke, Inc. Principals

are Norman R. Greve, structural engineer, and Thomas V. O'Rourke, civil engineer. C. G. De Swarte is a director of the new corporation. Both Greve and O'Rourke have been affiliated with De Swarte for the past 14 years. During the last four years both men have been profit sharing associates and have participated in business decisions, preparation of design plans and specifications, and supervision of construction of the firm's projects.

New address of Bricker & Busby, architects and engineers of Phoenix, Arizona, is 3201 North 3rd Street.

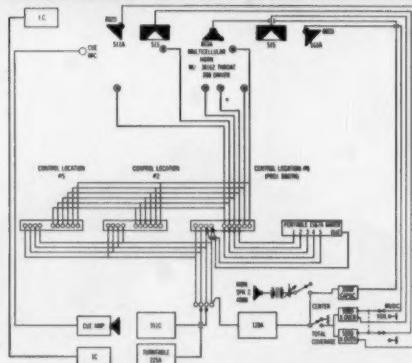
Daniel D. Wile, vice president and chief engineer of Recold Corporation, Los Angeles, became president of the American Society of Heating, Refrigerating and Air-Conditioning Engineers at its meeting in Dallas, Texas last month. Wile has been associated with the Society since 1934 and has served on many of its committees. □

Guggenheim Museum Sound Engineer* specified ALTEC



At the Solomon R. Guggenheim Museum in New York; at Disneyland; government buildings in Washington, D. C.; International Amphitheatre in Chicago; Convention Center in Las Vegas—throughout the world, in stadiums, auditoriums, hospitals, schools, churches, shopping centers, in government, commercial and industrial buildings—engineers and architects count on the sound leadership of ALTEC engineered sound products.

ALTEC sound systems, like all ALTEC products, are designed for dependable service under all conditions, for long life, and for ease of installation and service. A force of hundreds of ALTEC engineer-consultant-contractors is ready to serve you with more than 100 different ALTEC commercial



sound components and/or systems designed to your specifications. Before you specify commercial sound equipment, you'll want to talk to your nearest ALTEC contractor. For his address look in the yellow pages of your telephone directory or write to ALTEC at the address below.

See Altec's product listing in Sweet's Catalog Industrial Construction File (17e/AL), 1960 Edition.

* Sound Systems, Inc., Long Island City 1, N. Y.

ALTEC LANSING CORPORATION, Dept. CE-3D

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CLOSER LOOK AT
GAUGE BUYING
TODAY...**

**can help you pick gauges
that stay on the job**

Are you going to a higher price on gauges in order to make sure of gauge reliability? "Over-gauging" to get long life? It will pay to take a closer look at the size, flexibility, and high standards of accuracy of the United States Gauge line. At USG you can choose from over 50,000 standard indicating dial pressure gauges. Thousands of choices in case styles, sizes, materials, and in gauge components. Thousands of specials, too! Not only can you pinpoint your *reliability factor*, you can pinpoint your price for 99% of your gauge needs . . . from one line! It's easy to check . . . just call your USG distributor for your next gauge requirement. See the Yellow Pages, or write for catalogs and name of your distributor.



PICK exact Bourdon tube to meet stress, over-pressure, pressure range.



PICK Ni-Span "C" low pressure elements for exceptional thermal stability.



PICK Supergauge® for long life, accuracy to 0.5%.



PICK Solfrunt® for accuracy to 0.5%, solid-front safety from blow-outs.



UNITED STATES GAUGE

Division of American Machine & Metals, Inc., Sellersville, Pa.



PICK Test Gauges for dependability, and accuracy as high as 0.2 of 1%.



PICK Recorders and Recording Controllers built to stand vibration, pulsation.



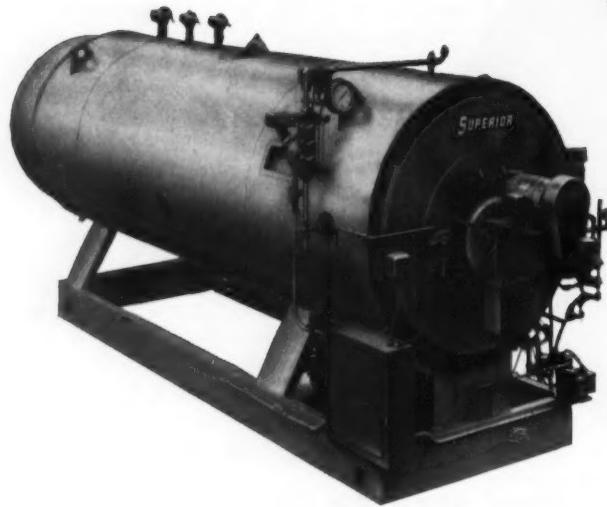
PICK A-Line for premium reliability, accuracy to 1%, and savings up to 40%.



PICK Arc-Loc® Movement for longer life, easier and lower maintenance.

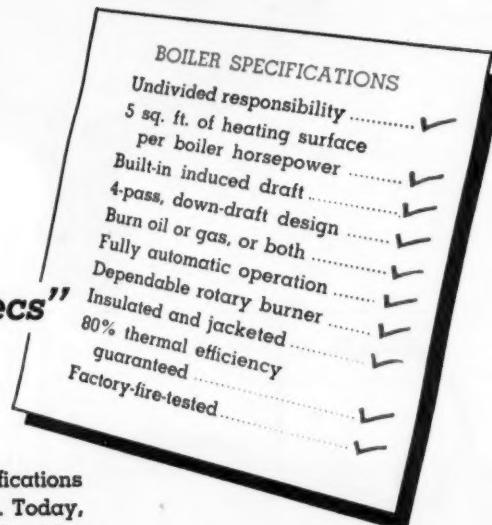


PICK U. S. Gauge Indicating Controllers or Transmitters for reliability.



This is the PACKAGED BOILER

that meets ALL the "specs"



Many packaged boilers will meet some of the specifications listed here. Superior Packaged Boilers meet them ALL. Today, more and more packaged boilers are being purchased on the specifications of architects and consulting engineers. Those consulting engineers are demanding that packaged boilers "measure up" to design and performance standards which assure buyers both operating economy and long-lived dependability.

Superior Packaged Boilers . . . built to the highest standards in the industry . . . meet the most exacting "specs", and usually exceed them. That is why Superior Packaged Boilers are so often recommended and so quickly approved by experienced consulting engineers.

In addition to the Type C, illustrated, Superior manufactures both fire-tube and water-tube boilers in a wide range of sizes which makes it the most complete line of fully packaged boilers available. If you will indicate the capacity in which you are interested, we will be happy to assist in the unbiased selection of boiler equipment suited to your specific operations.

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TIMES TOWER, TIMES SQUARE, NEW YORK 36, N.Y.

SUPERIOR
PACKAGED BOILERS

Reporting The New Projects

Master Plan for UCLA

The largest building program for an educational institution ever undertaken in the U.S. is under way at the University of California at Los Angeles. Initiated in 1949 under the over-all supervision of Welton Becket and Associates, it is estimated a total of \$307 million will be spent on 150 projects by the date of completion in 1967. The Becket firm has worked closely with UCLA's own Office of Architects and Engineers to develop a master plan for the campus and to supervise its incorporation. This plan provides for an orderly and functional grouping of academic, residential, recreational, parking, and circulation facilities. Since the inception of the plan, 20 projects have been completed at a total cost of \$60 million.

In general, the master plan divides the campus into three parts. The academic area in the east, the recreational area in the center, and the residential area in the west. Logically enough, the major construction effort has been in the academic area, including a \$30 million Medical Center. Planned



for the recreational area is a Memorial Activity Center for indoor athletics and additions to the men's and women's gymnasiums. The residential area will feature eight residence halls.

The projected enrollment for 1967 is 27,500 and this means a heavy demand on parking. Eight multi-level parking structures and several surface parking lots with a total of 15,000 parking spaces are being planned as a solution to this problem. The first of these, a six-level structure for 891 cars, is under construction.

Underground Swedish Power Plant

What is probably the largest underground steam power plant in the world, will soon be completed



Largest building program ever undertaken for an educational institution in U.S. is under way at UCLA.

in the solid bedrock of a mountain. Located near Stenungsund, Sweden, on the west coast north of Gothenburg, it will feed 700,000 kw into the Gothenburg power grid.

When construction was started in 1955, the plans called for only two sections of 100,000 kw each. As the project proceeded, it was determined feasible to increase the power capacity with new techniques, and the Swedish State Power Board approved a request to do so. As a result, two additional sections were added to the original plan.

Construction for the new plant required the removal of 1.5 million cubic yards of rock for the four underground machinery halls and the required access tunnels. Each of the first two halls are 410 feet long, 69 feet wide, and 98 feet high. The last two, now under construction, are somewhat larger. So far, cement consumption has totaled 16,000 tons, concrete 65,000 cubic yards, reinforcement iron 3500 tons, and structural steel, excluding boilers, 3000 tons.

Each section or machinery hall forms a separate unit with a ventilation system, a boiler, high and low pressure turbines, generators, and transformers. The amount of air required is 1260 tons per hour for each section and a unit for separating solid particles in the smoke gases treats 1.18 million cubic yards an hour with a purification degree of 90 percent.

Sea water is used for cooling and each two-mile long tunnel has a capacity of 52 cubic yards per second. The horizontal boilers are conventional and from them the steam is conducted to the high pressure turbines and back again for intermediate heating before being fed into the low pressure turbine. This system, which is familiar to most United States power consultants, improves operational economy although it involves a longer starting-up period.

The Stal turbogenerators are of a new design and utilize hydrogen for cooling. The high pressure unit has a rating of 39,000 kw and the low pressure unit has a rating of 111,000 kw. Both are designed for a speed of 3000 rpm. Power is transmitted over aluminum rails encased in steel tubing to the main transformers. The grid network is fed at a level of 130,000 volts.

A special harbor and pier for oil tankers to supply this plant have been built about a mile from the site. Tankers up to 65,000 tons can be accommodated and great care has been taken not to contaminate the water with fuel oil as this is a popular swimming and resort area.

By next fall, when the second section is scheduled for operation, the Swedish State Power Board will have invested \$40 million in this project. It will have doubled the thermal power capacity of the country. Normally thermal power accounts for less than five percent of Sweden's total power output but in drought years it can rise to 10 or 15 percent. For a short period last fall thermal power constituted one-third of the country's total production.

"HYDRATITE
keeps them
**WATER
TIGHT"**

says a satisfied customer!

Hydratite's effectiveness as an integral water repellent is due to its action as a concrete and mortar plasticizer that also minimizes initial shrinkage. The easy working of Hydratite treated concrete and mortar mixes, plus its increased ability to resist shrinkage, makes for tighter concrete and masonry work. And tighter concrete and masonry work, of course, is the real foundation for long lasting protection against water penetration.

For further information call or write Dept. CE-142



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Australian Railroad Project Tripled

A railroad modernization project begun last fall to rehabilitate a portion of the Northern Railway in the state of Queensland, Australia, has just been tripled in order to include the entire 750-mile line. From an initial \$22.5 million the budget is now set at \$67 million. The new program includes new trackage, bridges, motive power, rolling stock, yards, terminals, an office building, and other items. The New York consulting engineering firm of Ford Bacon & Davis, Inc. submitted a feasibility report on the entire project two years ago and just recently has been retained to engineer, design, and supervise its implementation. The northern interior of Australia, which the railroad services, contains sheep and cattle ranches and several mines, including the important Mount Isa mining and smelting properties.

Mechanical Mole

A recent tunneling project completed near Toronto, Canada presented a difficult burrowing problem for its builders. James F. McLaren Associates, con-

AT PENN
engineers burn the
midnight oil

DESIGNING
THE
BEST
IN
ROOF
VENTILATORS



*Penn's LOW CONTOUR DYNAFAN
cuts 50% off normal
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Write for Bulletin PD 42-LC



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PHILADELPHIA 40, PENNA.

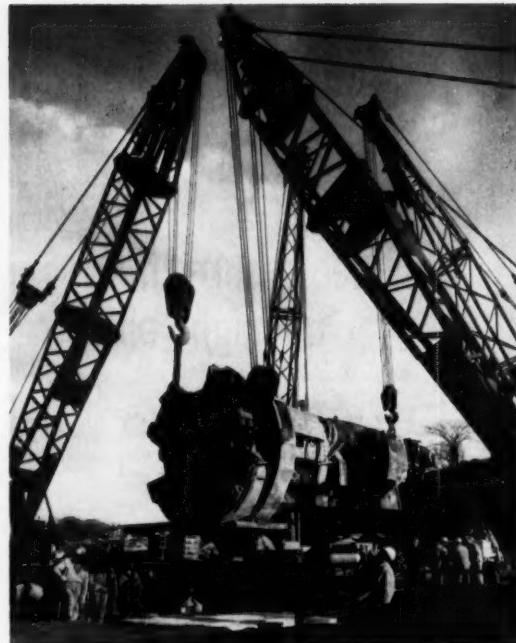
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sulting engineers of Toronto, recommended that a trunk sewer more than two miles long and 11 feet in diameter be constructed without disturbing the heavily built up area above it. The tunnel would lead to a new sewage treatment plant at the mouth of the Humber River in western Toronto. It was to run north and south along the west side of the river through mixed shale and limestone. As in all work of this nature, economy was a requirement.

Engineers of the Foundation Company of Canada Limited turned to the late James S. Robbins whose design ability had solved similar problems in the past. The result was a unique 60-ton mechanical mole called "Foundation Humber" capable of doing the required tunneling with a minimum of surface disturbance. The only evidence that burrowing was going on 35 to 100 feet below ground was the appearance of trucks carrying concrete which they poured through holes in the ground down to the tunnel level.

The tunneling machine itself is an imposing piece of equipment. Two 200-hp electric motors drive the business end of the borer, a 15-ton circular revolving head carrying the cutting discs. As the borer chews its way through the earth, the material is automatically passed behind the cutting head onto an elevated conveyor belt system. This belt dumps the excavated material into a train of 3-cubic-yard



Huge tunneling machine is handled by battery of mobile cranes. Unit is powered by two 200-hp motors.

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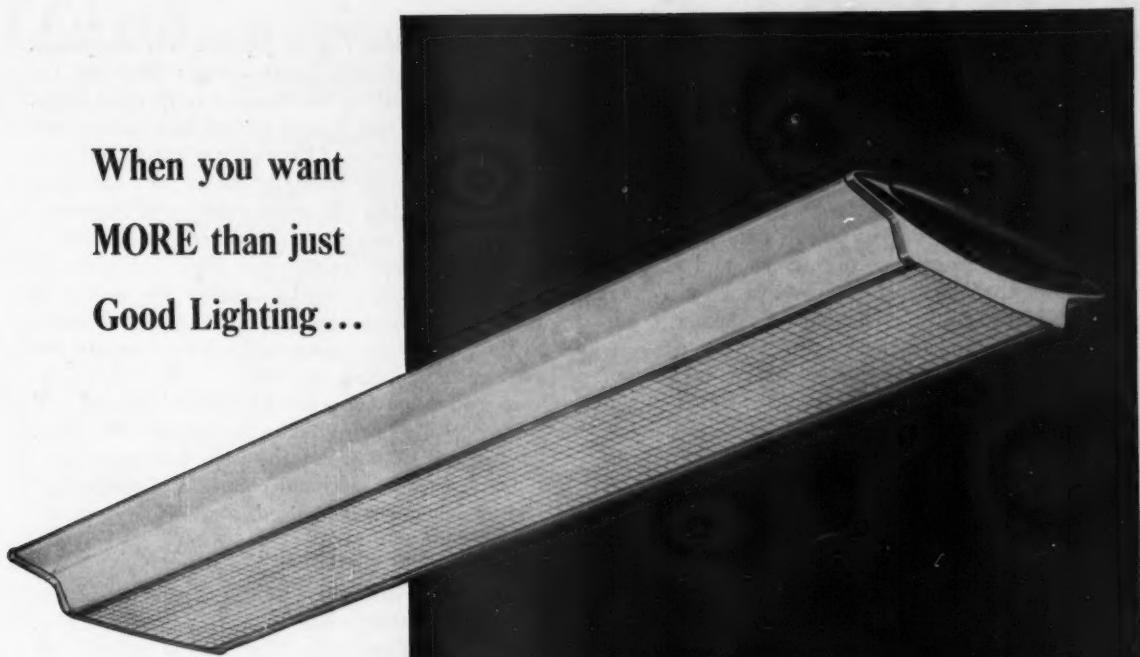
Trunk sewer line bored by mechanical mole is 11-ft in diameter, and runs through shale and limestone.

cars which sit under the machine. The train operator backs the cars one at a time under the machine until they are full, then moves down the narrow gage tracks, carrying the mixed rock and dirt to a dumping area outside the tunnel. A switch in the tracks enables an empty train to move under the tunneling machine as the full one leaves.

Lead Used to Sink Pipeline

Replacement of a worn out metal pipeline under seven fathoms of man-made lake could have been an expensive proposition for the residents of Mil-

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And the practical aspect has not been ignored either. In addition to its extreme attractiveness, the CLASSIC also provides other important features . . . high-quality lighting characteristics and excellent installation and maintenance advantages.

But a mere description of the CLASSIC is hardly adequate. To appreciate the true beauty and application possibilities of this series you should see the fixture itself.

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ton, Vermont. However, with the exercise of a little ingenuity and planning, Kenneth G. Miner, supervisor of the Milton Water Corporation, was able to do the job for a fraction of the anticipated cost.

When the problem became apparent a year ago it was decided to use flexible plastic pipe if proved practical. The alternative was to use metal pipe around or under the lake. The lake is used for boating and swimming in summer and is often coated with more than three feet of ice in winter. If the water line was to go under the lake, it would have to hug the lake floor.

Test results showed that ordinary methods of tying weights to plastic pipe, in order to sink it properly in place and hold it there, would damage the plastic pipe as it moved back and forth with the lake currents. Miner experimented over a period of months and came up with the following solution.

Using 3-in. wide, $\frac{1}{8}$ -in. thick lead sheeting strips and spacing them 8 to 12 feet apart, the pipe would stay submerged. In effect, the lead became a part of the pipe itself and would sway with it without chafing the pipe and wearing it through. The Milton Water Corporation made the decision to go ahead with the installation of the plastic pipe on the basis of the test.

A crew of six men was required. Lengths of 1 $\frac{1}{2}$ -in. flexible tubing were joined by metal couplings and

clamps until 3500 feet of pipeline was completed. Both ends were sealed with airtight plugs and the pipe was laid along the shore in large open loops. Next, the line was floated on the lake surface and towed into position. One end was connected to a line leading to the pumping station and the other end was towed to the opposite shore and connected to the service lines already installed five feet below the ground. Then the pipe was filled with water. It sank—but only to a level just below the surface of the lake. The boat crew inched along the full length of the pipeline wrapping the lead strips around the pipe at the specified intervals.

In one 8-hour day the job was completed and the new water line rested on the bottom of the lake. At the end of a week, the pipe was completely imbedded in the mud and plant life of the bottom and its movement minimized.

Voice of America Transmitter

Work on the first phase of the \$25 million short-wave broadcasting center for the Voice of America, located near Greenville, North Carolina, will get under way early this year. Bids have been submitted for clearing the 4000 acres of commercial pine forest that now cover the area. Eventually all of the east coast Voice of America programs will originate here, consolidating facilities now scattered along the eastern seaboard.

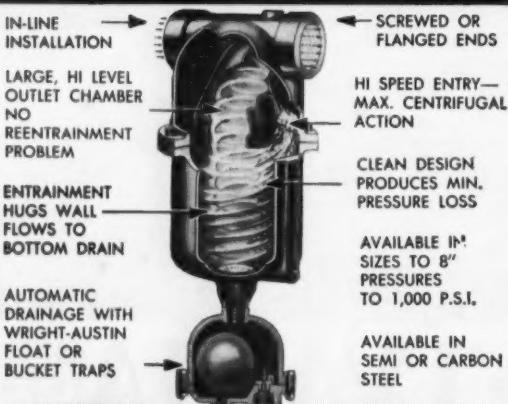
The prime factors that influenced the selection of the North Carolina site were the optimum propagation of radio signals and the noninterference with commercial, government, and military radio transmissions. A total radiated power of 4.2 million watts will make this one of the most powerful stations in the world.

The installation will consist of three sites, two transmitting stations and one receiving station, spaced about 18 miles apart in a triangular pattern surrounding Greenville. Each of the transmitters will be situated on sites of 2700 acres and the receiving site will consist of 650 acres. All three will be linked by microwave circuits and telegraph lines. These, in turn, will be linked with the broadcasting studios in Washington by connection to long distance telephone lines.

The Austin Corporation designed the Center with Smith Electronics, Inc. They state that one of the major problems on the project was the protection of personnel from the high RF energy in the transmitter buildings. Extreme care was taken in shielding, bonding, and grounding details.

The transmitting antennas are rhombic, curtain, and log periodic types, ranging in height from 50 to 375 feet. They will be arranged in a horseshoe pattern and designed to withstand winds of hurricane velocity. A total of 93 antennas, including

NEW T TYPE SEPARATOR IMPROVED CYCLONE DESIGN ASSURES MAXIMUM ENTRAINMENT SEPARATION



WRITE FOR

BULLETIN 810-A

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ROBERTSON

TEXAS' newest bank boasts Q-AIR FLOOR

the modern floor system that saves you money three ways

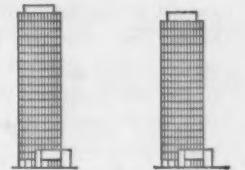
It is now more than a quarter of a century since H. H. Robertson Company developed and introduced Q-Floor, the strong, weight-saving cellular steel subflooring system that provides quick, efficient construction and continuous raceways for all types of wiring. This type of floor system has become the standard for commercial buildings. Now, something completely new and revolutionary has been added. Q-AIR

FLOOR not only carries telephone and power lines, but provides hot and cold air for air conditioning as well. Occasional pairs of extra-wide structural cells fit in with the normal Q-Floor system (with no change in the two-foot module) and carry the air to mixing units for discharge into the room.

This new system saves your capital and operating dollars in three distinct ways.

INITIAL CAPITAL INVESTMENT CUT 5%

Since Q-Air Floor permits an average saving of a foot of space between each floor, a twenty-story building can be built at the same height as a nineteen-story structure built by older methods resulting in a substantial savings in every building material that is installed from floor to floor.



An average of a foot per floor is saved by the Q-AIR FLOOR SYSTEM.

REDUCED BUILDING HEIGHTS CUTS BTU REQUIREMENTS 4% TO 11%

Heating and cooling are based primarily on exterior wall exposure. Therefore, a saving of 6" to 16" per floor can easily reduce BTU needs by 4% to 11%. This means lower capacity, lower cost equipment, effecting a saving on capital investment as well as in yearly operating cost.

3. Aerator mixes air in response to thermostat setting.

2. Air is carried through structural Q-Air cells to Aerators (mixing box) at windows.

Cutaway above shows method of air distribution through large structural Q-Air cells. Smaller structural cells provide raceways for all types of wiring.

Cutaway above shows method of air distribution through large structural Q-Air cells. Smaller structural cells provide raceways for all types of wiring.

YEARLY POWER COSTS CUT 30%

The Robertson Aerator, a patented outlet box which mixes and delivers air into the room in response to local thermostat setting offers an exclusive feature, the Seasonal Changeover which can reduce power requirements up to 30%. Full blower power is used only for peak summer cooling. The rest of the year the system can operate at about 65% of power requirement. Older methods demand constant 100% volume of air the year 'round—and thus, constant power use.



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400 antenna towers, will require 3000 tons of steel and more than 1500 guy wire anchorages. Project completion date is sometime in 1962.

Atomic Piles Tested With Compressed Air

Small, highly industrialized Belgium realizes that its future prosperity depends on the use of nuclear energy. With this in mind, a series of atomic piles have been under construction at Mol in the north central part of the country.

When two of the protective steel envelopes of the reactors were ready for pressure testing, it was decided to use air rather than water because the weight of the water would have crushed the envelopes. The tests also prescribed that the air used be dry, which implied not only a preliminary drying of the air supplied by the compressor units, but also the drying out of the atmosphere in the envelopes themselves.

One of the steel towers had a volume of 1,059,441 cubic feet and was tested at a pressure of 17 psi. The other tower had a volume of 229,545 cubic feet and was tested at 64 psi. In each case, a portable air compressor capable of developing 575 cfm was used to develop the initial test pressure, while another type of compressor, rated at 160 cfm was used to maintain pressure during the required test period. Four air scrubbers were connected into

each air circuit and by means of one-way valves the atmosphere from the envelopes was circulated at a pressure of 99.5 psi in the final coolers for a period



Reactor envelope for atomic power plant in Belgium was pressure tested with air instead of water.

of 18 hours. This allowed the condensation water to separate from the air.

After taking suitable safety precautions, the coolers were disconnected and the envelopes brought up to the test level. Ultrasensitive microphones were used to detect any leaks. The tests were a complete success.

Quality Control Laboratory Designed

A new quality control laboratory was recently designed by the Pittsburgh firm of Hunting, Larson and Dunnells, for the Alco Products Corporation. The 8000-sq ft facility, located at Latrobe, Pennsylvania, is completely air conditioned and equipped with the latest testing and processing devices.

The metallurgical lab, in addition to complete photographic facilities, has the latest polarized light equipment with phase contrast attachments. The chemical analysis section has equipment for the analysis of gases in metals, and the mechanical testing area includes a full complement of machine-shop equipment for machining samples and preparing specimens. Other specialized equipment includes a 300-pound ingot induction furnace for alloy development, a Leitz research dilatometer for thermal analysis, creep test machines, and four Navy-type roller machines for testing surface wear and abrasion resistance.

Warsak Dam Nears Completion

Completion of the Warsak Dam early in 1961 will more than double the power output of Pakistan. In addition, it will irrigate 120,000 acres of desert land on the Northwest Frontier. The project, part

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of the Colombo Plan, was started in 1957, and over 10,000 Pakistanis led by 200 Canadian engineers and designers have labored here near historic Khyber Pass in temperatures reaching 120 F.

The dam, across the Kabul River, is 750 feet long and 235 feet high with a base width of 211 feet and a top width of 19 feet. The reservoir extends 26 miles to the Afghan border with an average width of 1000 feet.

There are two irrigation tunnels. The southern one is 3½ miles long and extends through the Mullahgori Hills to irrigate the Peshawar region. On the northern side, a similar tunnel burrows through the hills for 1½ miles to irrigate the Mohmand tribal lands. The power house on the southern bank is fed by a 717 ft tunnel leading to the six generators.

The Warsak Dam is undoubtedly Pakistan's largest industrial project. In its first phase of operation, it is expected to increase the annual income of West Pakistan by \$100 million.

George Washington Bridge

The first section of the new lower deck of the George Washington Bridge was installed recently without disruption of regular top level traffic. Two trolleys lifted the partially assembled section 200 feet above the shoreside assembly area and then, using new permanent structural members as tracks,

carried the section 650 feet to the eastern abutment directly over the Henry Hudson Parkway. As a safety precaution, this first section was moved in



First section of new lower deck of George Washington Bridge was lifted into position with two trolleys.

place and fastened during the early morning hours while traffic was routed safely around the construction area.

In all, there will be 76 such sections installed using modifications of the same technique. The total amount of steel to be used in this project is 13,875 tons and the entire cost of the lower level six-lane roadway will be \$183 million. This sum includes the expanded approaches in both New York and New Jersey which will be completed in 1962. O. H. Ammann of New York City is the consultant and G. P. Adair, Bethlehem Steel's district manager of erection, is in charge of the steelwork.

Air Conditioned Dome

The new Pittsburgh Public Auditorium will have the largest movable dome in the world. Air conditioning for this sometimes open, sometimes closed, auditorium was designed by John W. Mullins and Associates, consulting engineers of Pittsburgh.

All of the public spaces in the auditorium are air conditioned. In addition to the dome, which is 12 stories high and mostly air space, there are three working levels. The first floor contains 50,000 square feet of exhibition area, two meeting rooms, and the main air conditioning mechanical equipment room. The second floor contains the main entrance and box offices as well as several office suites. The top level has seats on one side and a control booth on the other.

The air conditioning system is a high pressure heating, ventilating, and cooling system weighing 1200 tons. It is so designed that only that portion of the building which is in use will be supplied with

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time, work and money on handling and installation.

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conditioned air. The main arena circulation equipment is contained in eight fan coil equipment rooms and is capable of discharging 280,000 cfm of conditioned air throughout the arena.

Amador County Master Plan

Amador County, one of California's Mother Lode Counties, and one of the state's finest recreational areas, is preparing a long range master plan for its impending building boom. The consulting engineering firm of Wilsey & Ham of Millbrae has been retained for this purpose.

The first step recommended by the consultants is the preparation of an interim zoning ordinance to prevent land abuse and promote conservation of natural resources while the general plan is being prepared. This general plan will provide for the orderly exploitation of natural resources for the maximum benefit of the county and its inhabitants. It will be a guide to buildings, highways, zoning, and public works, while still retaining colorful segments of the past, such as old mining camps, as tourist attractions.

Supersonic Wind Tunnel

A propulsion wind tunnel is nearing completion at Tullahoma, Tennessee. Powered by the world's largest rotating machine, the tunnel can develop

air velocities from 1000 to 3000 miles per hour. Located at the U.S. Air Force's Arnold Engineering Development Center, this new supersonic wind



Air Force's new supersonic wind tunnel can develop wind velocities from 1000 to 3000 miles per hour.

tunnel will be capable of testing the latest designs from the U.S. missile and space programs under nearly ideal conditions.

The main propulsion unit consists of four compressors, with a total of 21 stages, driven by four giant motors. Three of the compressor stages are used for the transonic circuit and the remaining 18 are used for the supersonic circuit. The world's two most powerful synchronous motors, each rated at 83,000 horsepower, and two smaller "starting" motors, of 25,000 horsepower each, are connected in tandem to develop 216,000 horsepower. Both the compressors and the motors were manufactured by Westinghouse. The Center is operated for the Air Force by ARO, Inc., a subsidiary of Sverdrup & Parcel, Inc., engineering consultants located in St. Louis, Missouri.

Prestressed Concrete Bridge in Wales

The London consulting firm of Rendel, Palmer & Tritton has designed an interesting bridge over the Usk River, near Abergavenny in Wales. Designed to carry extremely heavy loads the new bridge will be 200 feet long and 46 feet wide. The deck, which consists of a three-lane roadway and a sidewalk on each side, is constructed of a prestressed post-tensioned continuous concrete slab 120 feet between supports. Two side spans 40 feet long are similarly stressed. Main prestress is provided by Magnel-Blaton cables running the full length of the deck. Additional prestress is furnished over the supports and in the center span by alloy bars located at the



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A Stromberg-Carlson paging and background music system is wired to provide stereophonic sound throughout the new Utica, New York, Memorial Auditorium.

Coverage is complete, with an end cluster of cellular horns plus high fidelity woofers and coaxial speakers, and a center cluster of cellular horns and coaxial speakers. The end cluster provides perfectly-placed single-source sound for stage presentations.

Other outstanding features of the system:

- 750 watts of audio power
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- Telephone intercom and paging network throughout the building
- 18 microphone circuits plus 8 additional input sources

- Three different programs can be directed to different areas simultaneously

Because it is "custom-engineered" from standard components, this system assures unusual efficiency, economy, and ease of installation.

These advantages are available to meet the needs of your clients. Our field engineers will be glad to consult with you on any project. Our factory-trained distributing organization is ready to handle all installation and maintenance problems. You'll find their names in the Yellow Pages under "Public Address & Sound Equipment," or write to Special Products Division, 1440-03 N. Goodman Street.

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Stereophonic sound reproduction is a unique feature of the Stromberg-Carlson paging and sound reinforcement system in the new Utica, New York, Memorial Auditorium. Architects: Gehran & Seltzer of New

York City. Associate Architect: Frank C. Dell'Osso of Utica. Consulting Engineers: New York City office of Fred S. Dubin Associates. Installation by W. G. Brown Sound Equipment Corp., Syracuse, New York.



top and bottom of the slab. Transverse strength is provided by steel reinforcement.

The two intermediate supports consist of six V-shaped piers cast monolithic with the deck and hinged to the foundations. The outer legs of the piers are post-tensioned. To allow for longitudinal expansion, the ends of the side spans are supported on flexible reinforced concrete bearing walls located immediately in front of box-type abutments.

Second Nuclear Research Center for Canada

The Whiteshell Nuclear Research Establishment, located 60 miles east-northeast of Winnipeg, is scheduled to be Canada's second such facility. Shawinigan Engineering Company, Ltd., a consulting engineering firm from Montreal, has been retained by Atomic Energy of Canada Limited to provide the over-all planning and site development. It also directed the preliminary studies of the 11,000-acre site.

The new center will start as a small unit and expand as nuclear research requirements increase. It could, conceivably, reach a size comparable to that of Chalk River, which has grown steadily since it was established in 1944. At present, a few access roads will be built and a new bridge across the Winnipeg River is being considered, but the building of the major facilities will not begin until 1961. It is possible that the first experiment here will be

an organic-cooled, natural-uranium-fueled, heavy-water-moderated, power reactor.

The decision to go ahead with the new nuclear research center is a development of the announcement last October by the Hon. Gordon Churchill, Canada's Minister of Trade and Commerce, that a new nuclear research facility would be built to accommodate expansion of nuclear development. Canada's big Chalk River, Ontario, establishment is considered to be of optimum size for efficient operation. Among the major facilities at Chalk River are five research reactors, including the NRU and NRX reactors; particle accelerators; research laboratories; and chemical and metallurgical plants. The number of workers is nearing 2500, including over 400 university graduates.

Overwater Runway

Santa Cruz airport, located at Bombay, India, will soon be the second international airport with an overwater runway. The first was at Kaitak Airport, Hongkong, which projects a runway into the sea on a man-made peninsula of rocks and concrete. At Santa Cruz the runway extension will cross Mahim Creek, an inlet of the Arabian Sea, on a 100-ft long bridge.

Several problems faced the designers. Westward extension was possible for only 800 feet as a railway, a highway, and high tension lines barred any further progress. Extension to the east involved building the bridge mentioned above with a capacity ample for the impact of a heavy jet aircraft like the Boeing 707. In addition, hills stuck up into the approach paths from the east and they would have to be leveled off. However, it was decided to proceed with this plan because of the possible extension of the runway up to 12,500 feet later. The new runway extends 10,500 feet.

A new parking apron for aircraft is planned as a part of this project. This will provide three additional bays and room for three more. A new refueling hydrant capable of delivering 1000 gallons of jet fuel per minute is also to be furnished.

Thermal Power Plant for Sicily

A World Bank Loan has completed the financing of a \$32 million thermal power plant located at Augusta on the eastern coast of Sicily. The World Bank Loan covers one-third of the cost, with the balance being supplied by private Italian sources.

When completed, the plant will have an annual rated capacity of 225,000 kilowatts or 1.2 billion kilowatt hours. Major equipment will consist of three turbogenerators, each capable of producing 75,000 kw. Sicilian demand for 1958 was 1.1 billion kilowatt hours and any excess will be used to supply power to the Italian State Railways.

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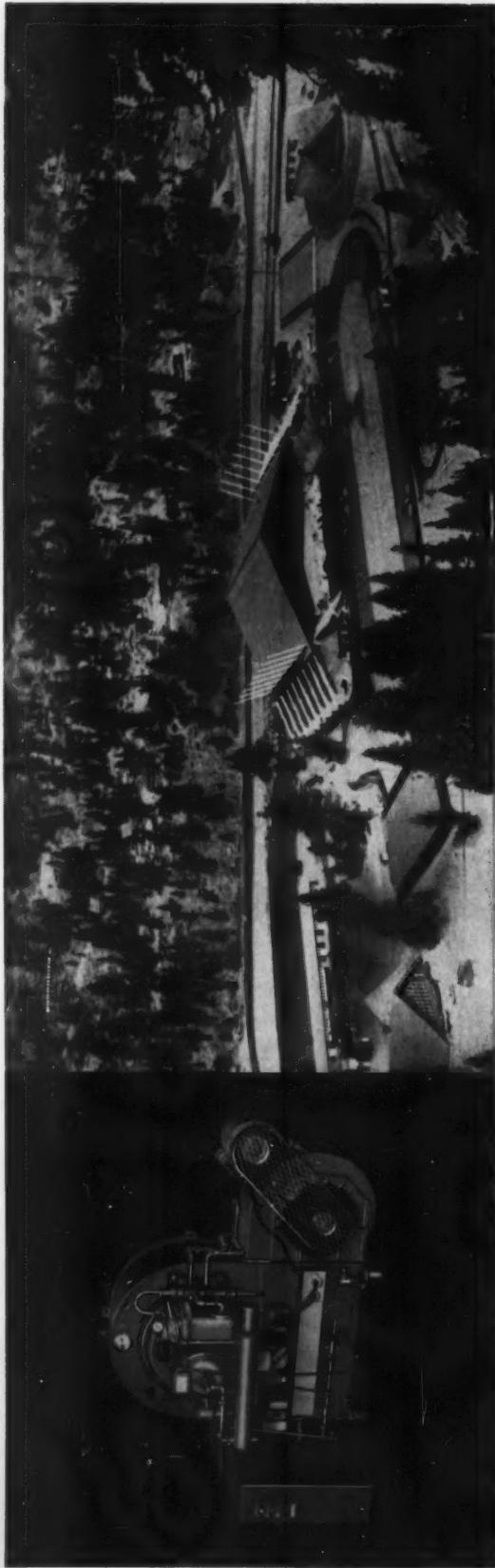
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Installing a DeBothezat Bifurcator Fan is about as quick and simple as putting in a section of ductwork. Direct drive eliminates recurring maintenance problems. From space-saving installation to long-term operating economy, DeBothezat Bifurcator Fans keep costs down all the way. For detailed specifications on Bifurcator Fans, contact a DeBothezat Sales Engineer or write direct. Address Dept. COE-360.

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Books

Parallel Reading for Consulting Engineers

Under the streets of New York lie buried some of the finest examples of engineering skill and political skulduggery to be found anywhere in the world. Looked at in the perspective of history, they give strong credence to the theory of some political observers that progress is the province of scoundrels. *The World Beneath the City*, by Robert Daley, begins with the City's water problems, which date back to the 1600's, and concludes with the scheduled cleanup of the subway in early 1959. The scoundrels along the way are many, and most of them interesting. Interesting, too, are the engineer-inventors of the early days of New York City. Unfortunately, they seem to almost always have been outwitted by the scoundrels.

Daley's little book moves along with the rapid pace of a news story, which is to be expected, since he himself is a newspaper man. Its skillful blending of fact, fiction, and human interest glamorizes the world of engineering — without glamorizing engineers.

As a matter of fact, three engineers come off rather badly. James Rice, chief engineer who had drawn up the specifications for the Queens sewer network fortunately turns out not to have been an engineer after all — in spite of his title. But Frederick Seely, engineer in charge of design, and Clifford B. Moore, consulting engineer, seem to have merited their titles on a technical, if not ethical, basis.

All of these men were involved in the Queens sewer scandal of 1928, and all paid a higher price for their indiscretion than did Borough President Maurice E. Connelly, obviously the biggest culprit.

However, it should be made clear that these men occupy little more space in the book than they deserve. For who would care to dispute the importance of the unique talent of "Smelly" Kelly the subway sniffer or doughty little Teddy May, a real life Art Carney who was king of the sewer system. Compared to these two, even Boss Tweed is just another politician.

The World Beneath the City is pleasant reading for anyone with a nostalgia for New York City, but particularly for engineers who, immersed in the details of current projects, may forget what an interesting profession they practice.

•

Louis Napoleon Bonaparte was in prison in 1842 when he wrote "I want to be a second Augustus." Ten years later he was, if not quite an Augustus, at least the Emperor of France. He took the title of Napoleon III and immediately set about rebuilding Paris as Augustus had rebuilt Rome.

Napoleon III had a clear and sound idea of what he wanted to do. It was no small undertaking. He wanted to change Paris from a dirty overcrowded, nearly medieval city into the beautiful, broad boulevardeed capital of the Empire.

Even during the two years that he served as an elected president before taking over the government as Emperor, he had his maps drawn and his plans formulated. He was stopped by the conservatism of the Prefect of the Seine, Jean Jaques Berger, but he overcame this as Emperor by firing Berger and hiring in his place the ideal bureaucrat, Georges Eugene Haussmann, later Baron Haussmann. There was in Haussmann none of the conservatism of Berger, and he managed for 18 years to prove that, with the right bureaucrat, Parkinson's Law is reversible. He always managed to find the money for any project the Emperor desired.

Haussmann was not himself either an architect or an engineer, as is commonly thought. He was a grand planner, second-grand only to Napoleon himself, but he depended upon practicing architects and engineers to actually design and supervise his many projects.

Haussmann was more practical than Napoleon in one way. He recognized that the remodeling of the city was not all a matter of surface operations. He understood the need for a better water supply and both storm and sanitary sewer systems. Napoleon was not much interested in these underground operations because they did not show, but he by no means discouraged them and backed up Haussmann, generally speaking, in most of his engineering efforts.

To give technical credit where it was due, Eugene Belgrand was the engineer who designed the water systems bringing in spring water from the river valleys, and it was he who designed the great Paris sewer system still shown to visitors as one of the proudest projects of the city. Another engineer, Adolphe Alphand, was chief of the Paris park service and was responsible for the engineering and landscaping of the Bois de Boulogne and for the planning and construction of the other great parks and public squares. He must



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have kept his nose clean, for he survived both the fall of Haussmann and the fall of the Empire, and under the Republic he came closer than any other man to being Haussmann's successor.

Professor Pinkney's book is a fine piece of research, and for the most part, it makes interesting reading. Unfortunately, it gets off to a rather bad start in its second chapter, "The Plan and the Men," in which it loses the reader in a mass of street names and directions. In fact, there has never been a book that suffered so much for the need of a good map. It is impossible to follow the author, sometimes for many paragraphs on end, without frequent reference to a map of Paris, and this volume contains nothing but a few poorly done sketches of sewers and parks. This near disastrous omission is partially saved by the inclusion of a section of excellent engravings and contemporary photographs that picture for the reader some of the major projects planned by Napoleon III and Haussmann.

Books Reviewed in This Issue

The World Beneath The City, by Robert Daley; J. B. Lippincott Company, Philadelphia, Pa.; \$3.95.

Napoleon III and the Rebuilding of Paris, by David H. Pinkney; Princeton University Press, Princeton, N.J.; \$6.00.

New Technical Books

1960 EUROPEAN TECHNICAL & COMMERCIAL TRADE FAIRS; published by European Technical Coverage Inc., 75 East Wacker Drive, Chicago 1, Illinois; \$5.00. Designed for the engineer, scientist, or business man who wants to keep current on new products and processes developed abroad, this guide list contains over 500 major European trade fairs scheduled in 1960. Shows in 25 countries and 41 market and product classifications are covered. As an aid in planning travel schedules, there are two in-

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dexes, adequately cross-referenced. One is chronological and the other is geographical.

As an example of the exhibits that the well-traveled engineer may see this year we find a Nuclear and Electronic Exhibition being held in Rome (June 15-19), the Golf Traders' Exhibition at, naturally, St. Andrews, England (July 3-8), the European Bread, Pastry and Gastronomy Professional Show in Brussels (October), and the International Inventors' Exhibition also being held in Brussels (March 11-20).

BIBLIOGRAPHY ON FILING, CLASSIFICATION, AND INDEXING FOR ENGINEERING OFFICES AND LIBRARIES (ESL Bibliography No. 14); published by The Engineering Societies Library, 29 West 39th St., New York 18, N. Y.; \$2.00. This is a selected list of references prepared for engineers and librarians concerned with organizing their own files or the files in the office where they work. The references are to books, pamphlets, and magazine articles on filing, classification, and indexing, lists of subject headings, and hand-sorted punched-card systems suitable for organizing small collections of engineering books, notes, correspondence, abstracts, reprints, drawings, maps, manufacturers' catalogs, and specifications.

There is a subject index and an introductory section in which selection and use of the systems are discussed.

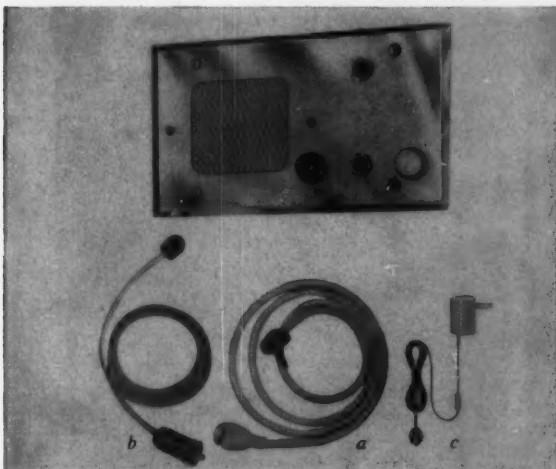
SUBSURFACE MAPPING, by Margaret S. Bishop; John Wiley & Sons, New York; \$5.75. Graphic representation of the earth is an indispensable tool for the petroleum and mining engineer. For the civil and structural consultants it is almost as valuable. Certainly the variety of maps and charts needed for this work belie their importance. It is a service to these men, then, that the author provides as she tells how to prepare and interpret this kind of material. Both the theoreti-



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cal and practical value of recent developments are studied and recommendations are made for their most effective use in recording vital information. Some of the types of maps considered at length are contour, topographic, stratigraphic, isopach, facies, paleo-geographic, geophysical, and geochemical.

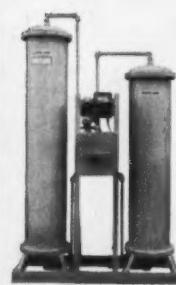
ARCTIC ENGINEERING, cite No. PB 151984, Bureau of Yards and Docks, U. S. Navy; order from: OTS, U. S. Department of Commerce, Washington 25, D. C.; \$6.00. The Bureau of Yards and Docks has been the Navy's technical agency responsible for construction of shore facilities. As a result they have devoted much time and effort to study of the effects of low temperatures on materials, the theory of heat transfer, the techniques of snow compaction, and the other developments for speeding construction and reducing the cost of bases in the cold regions.

The handbook covers characteristics of the arctic regions; site selection and sampling; characteristics of snow, ice, and permafrost; construction of foundations and drainage facilities; heat transfer, loss and absorption, and temperature measurement; construction materials; structural design criteria; design of utility ducts and tunnels; heating, ventilating, and air conditioning; power generation and distribution, and lighting; design of roads, runways, and railroads; water supply, sewage, and waste disposal, and garbage and refuse disposal; examples of arctic structures; fire problems, planning for polar construction; transportation of construction materials; snow compaction for roads and landing fields; concrete practice; and construction equipment and maintenance.

PRINCIPLES OF PAVEMENT DESIGN, by E. J. Yoder; John Wiley & Sons, Inc., New York, N. Y.; \$13.25. Ba-

sic principles of pavement design and their applications are the subject of this text. A great majority of this material was used originally as the basis for a series of graduate level lectures at Purdue University where the author is now Associate Professor of Highway Engineering. However, due to the inclusion of suitable correlative data, the book can be used at the undergraduate level.

For reference purposes, the volume has been divided into five parts. In Part I fundamental principles are discussed. Design tests and properties of pavement materials are discussed in Part II. In Parts III and IV, the author deals with design methods and each method is presented as a practical problem. Part V is a study of pavement failures and methods of strengthening pavements. Throughout the book both highway and airport pavement design problems are considered. It is an excellent reference volume. □□



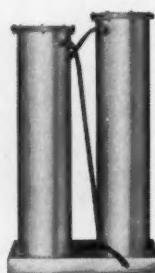
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March 6-9. American Society of Mechanical Engineers; Gas Turbine Power and Hydraulic Conference, Rice Hotel, Houston, Texas.

March 7-8. University of Florida, Mechanical Engineering Department; Annual Heat Transfer Symposium.

March 7-11. American Society of Civil Engineers; New Orleans Convention, Jung Hotel, New Orleans, La.

March 14-17. American Concrete Institute; 56th Annual Convention and Exhibit, Commodore Hotel, New York, N. Y.

March 15-17. National Association of Corrosion Engineers; 1960 Corrosion Show and Annual Conference, Dallas, Texas.

March 23-26. Electrical Maintenance Engineers Association of Southern California; Electrical Industry Show and Lighting Exposition, Shrine Exposition Hall, Los Angeles, Calif.

April 3-8. Engineers Joint Council and Instrument Society of America; Sixth Nuclear Congress, New York, N. Y.

April 11-13. American Institute of Electrical Engineers; First Conference on Electrical Engineering in Space Technology, Baker Hotel, Dallas, Texas.

April 18. The Producers' Council; Spring Meeting and Board Meeting, Mark Hopkins Hotel, San Francisco, California.

April 18-19. American Society of Mechanical Engineers, Institute of Radio Engineers, and American Institute of Electrical Engineers; Third Annual Conference on Automatic Techniques,

Cleveland-Sheraton Hotel, Cleveland, Ohio.

April 19-21. Building Research Institute; Spring Conference, Statler Hilton Hotel, New York, N. Y.

April 27-30. Western Air Conditioning Industries Association; 3rd Western Air Conditioning, Heating, & Refrigeration Exhibit & Conference, Shrine Exposition Hall, Los Angeles, Calif.

May 4-6. Consulting Engineers Council; Board of Directors Meeting, Gearhart, Oregon.

May 15-20. American Water Works Association; Annual Conference, Bal Harbour, Florida.

May 23-26. American Society of Mechanical Engineers; Design Engineering Conference and Show, Statler Hilton, New York, New York.

June 5-10. American Society of Mechanical Engineers; Semiannual Meeting and Aviation Conference, Statler Hilton, Dallas, Texas.

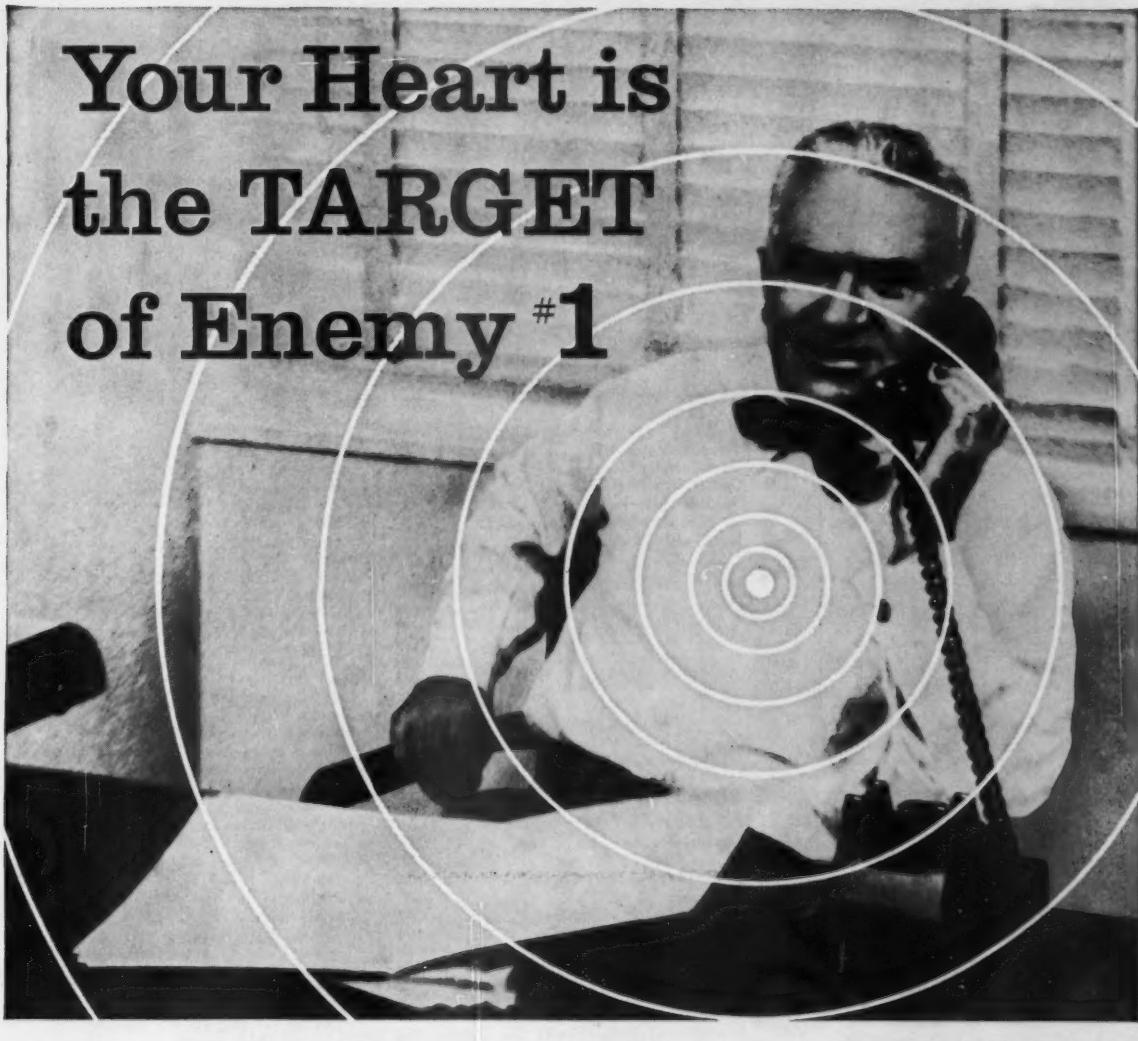
June 13-15. American Society of Heating, Refrigerating and Air-Conditioning Engineers; Annual Meeting, Royal York Hotel, Vancouver, B.C., Canada.

June 13-17. American Society of Civil Engineers; Conference on Shear Strength of Cohesive Soils, University of Colorado, Boulder, Colorado.

June 19-22. American Institute of Chemical Engineers; General Meeting, Del Prado, Mexico City, Mexico.

July 10-22. Pennsylvania State University; Seminar on Atomic Shelter (architectural and engineering planning aspects), Campus.

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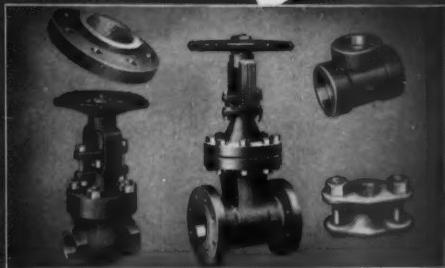
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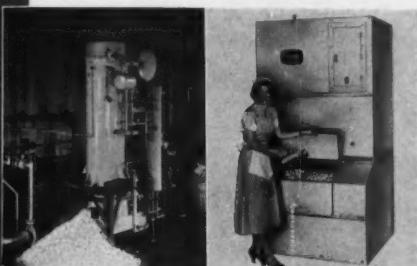
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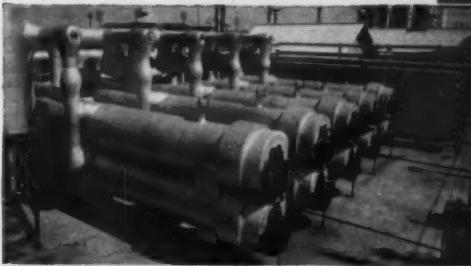
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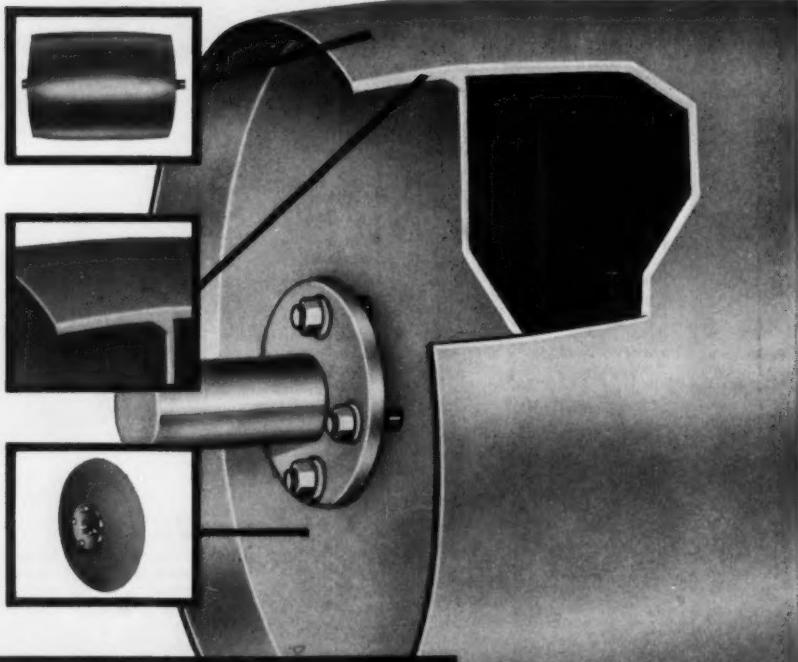
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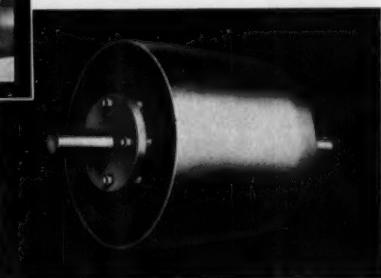
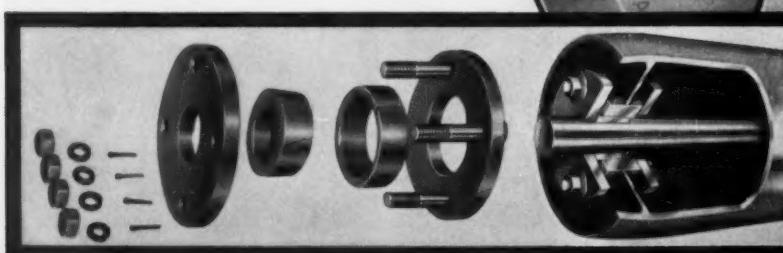


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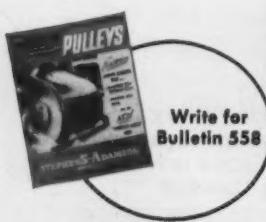
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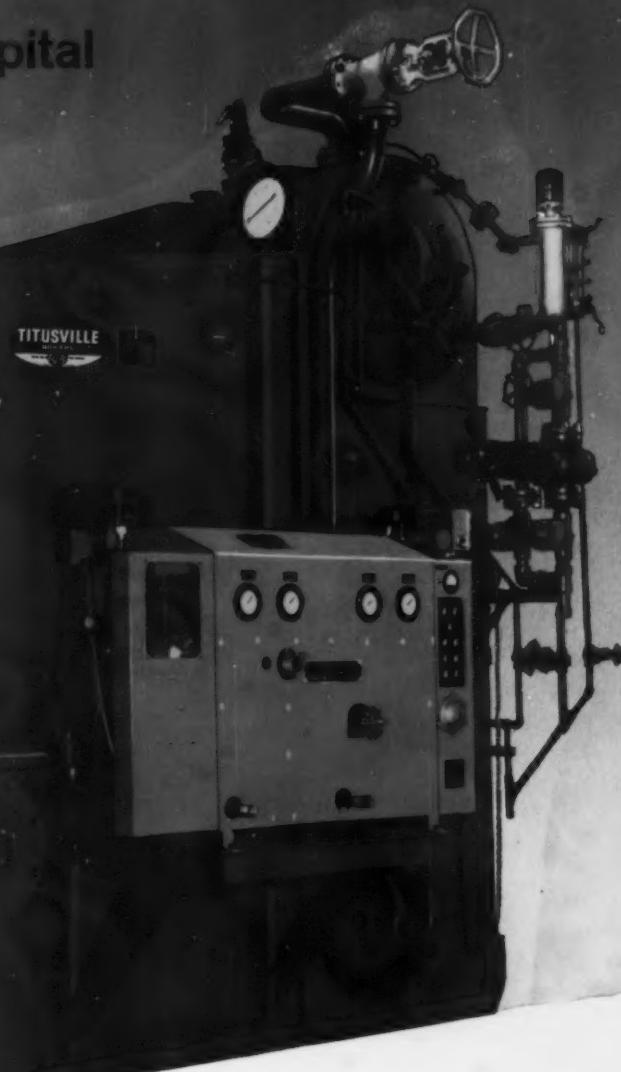
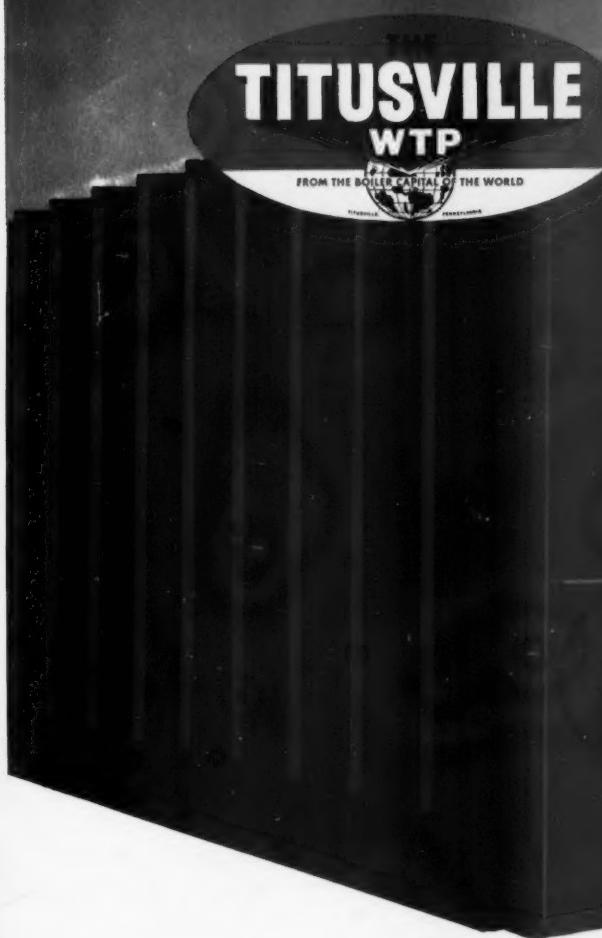
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